ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL

VOL. XXIV. No. 27.

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THE CAPE HATTERAS LIGHTHOUSE BIDS for the erection on Outer Diamond Shoal, off Cape Hatteras, of what will probably be the greatest lighthouse in the world, under conditions described in our editorial of May 31, 1891, were opened July 1 at the office of the Lighthouse Board in Washington. By the kindness of Major JAS. F. GREGORY, Engineer Secretary, we are enabled to present the following schedule of bids, which includes the complete construction and equipment and temporary maintenance (for one year at contractor's risk) of the light:

Name and Address of each Bidder.	Amount of each bid	Proposed time of completion.
Theodore Cooper & Co., New York City	$474,000	Jan. 1, 1893
Anderson & Barr, Jersey City, N. J	485,000	Jan. 1, 1892
William Sooy Smith, Chicago, Ill	488,325	Three years from date of contract.
James Andrews, Allegheny City, Pa.		
Gustav Lindenthal, Pittsburgh, Pa.	1,820,300	24 months from date of contract.

THE THREE LOWEST BIDS are wonderfully close together; so close that they would distinctly suggest collusion in an ordinary contract; but in this case the circumstances and the high character of the bidders, each of which, beyond doubt, was as anxious to secure the contract for professional as for financial reasons, forbids even the suspicion of such a thing. This being so, that fact that three eminent engineering firms differed by *less than three per cent.* in their estimate of the probable cost of constructing one of the most hazardous and dubious pieces of engineering construction ever attempted shows the exactitude to which engineering construction has been brought. It is possible, indeed, that all three of these gentlemen have made a mistake, and that Mr. LINDENTHAL'S very much larger bid is the more prudent one; but the presumption is all against this.

EXCEPT FOR THE ELEMENT OF TIME, the bid of Mr THEODORE COOPER and his associates, as the lowest bid, would undoubtedly be accepted, but including the element of time, the bid of Anderson & Barr becomes notably the lowest, and as the immense experience and world-wide reputation of the firm give every assurance that they know what they are bidding on, and will do what they offer to, we should judge their chances were slightly better for getting the contract. Still, the final choice will depend largely upon the opinion of the Lighthouse Board as to the comparative merit of the plans. Allowing one month as the necessary time for closing a contract, the respective bids on time, from July 1, 1890, stand as follows: Anderson & Barr, 18 mos.; Lindenthal & Andrews, 25 mos.; Theodore Cooper & Co., 30 mos., and Wm. Sooy Smith, 37 mos. As the value of the lighthouse to navigation can hardly be estimated at less than $4,000 per month, it will be seen that this element will make a considerable difference in the face of the bids, if the Lighthouse Board are at liberty to consider this element at all, as to which we are not fully advised. In any case the Government is likely to get a very cheap lighthouse.

A PROPOSED ALLIANCE of the Atchison, Topeka & Santa Fe and Missouri Pacific railway companies is causing much interest in financial circles. While actual consolidation is probably a good way in the future, it is not at all improbable that a traffic arrangement sufficiently close to avoid destructive competition between these two great rival systems which, together, control the great bulk of the railway mileage of the southwest may be entered into. The extent and importance of the lines controlled by the two companies may be seen by reference to our map of Southwestern Railway systems published July 20, 1889, remembering that since that date the St. Louis & San Francisco system has been consolidated with the Atchison.

THE WORST ACCIDENT OF THE WEEK happened on June 28 at Joliet, Ill., to the Kansas City vestibuled express of the Chicago, Rock Island & Pacific Railroad. The train was split at a switch, the engine, baggage car and smoker passed over all right, but the other four cars were derailed and the first one was dragged along after the smoker and was wrecked and torn to pieces by collision with the truss of a bridge over the street. Two passengers were killed and about a dozen were seriously injured. The accident is quite similar to the Bradford derailment on the Boston & Maine two years ago, and is a fresh illustration of the danger of facing point switches when not protected with every safeguard.

TWO OTHER SERIOUS DERAILMENTS ascribed to the spreading of rails occurred near Copetown, Ont., June 23, on the Grand Trunk Railway, and near Nevada, Mo., June 29, on the Missouri Pacific. In the former case the testimony tended to show that the buckling of the rails by the heat was the cause of the disaster. One passenger was killed and seven others suffered serious injuries. In the Nevada accident two were fatally injured.

AMONG OTHER WRECKS was a head collision of two freight trains near Vincennes, Ind., June 25, killing a young man who was stealing a ride and the engineer of one train. The other engineer claimed to have made a mistake of one hour in reading time by his watch.——A train on the Northern Pacific railroad jumped the track near Drummond, Mont., June 30, and two sleepers were thrown down a 30-ft. embankment. One passenger was fatally and a dozen others seriously injured.——In the city of Grand Rapids, Mich., June 25, a Detroit, Grand Haven & Milwaukee train was wrecked by a tie placed on the track by two men who fled just as the engine came in sight. The fireman was killed outright.——The Boston express on the Lake Shore & Michigan Southern Railroad had a remarkable escape from serious disaster on the night of June 25, at Cleveland, O. Three cars loaded with ice, which had been left on a siding, got loose and ran down on the main track and were struck by the engine of the express. After the collision it was found that the drawspan of the bridge a few rods distant was open, so that the train would have gone off the track into the pit had it not been stopped by the collision.

BRIDGE ACCIDENTS REPORTED are the collapse of a wooden toll bridge 40 years old over the Connecticut River at North Stratford, N. H., June 25. The structure fell about 20 ft. into the river, carrying down with it a 4-horse team and three men. At the French port of St. Jean a footbridge leading from a steamer to a landing stage collapsed on May 25 and a large number were thrown into the sea. Seven bodies have been recovered. An old wooden bridge over the Navidad River in Jackson County, Tex., fell on June 24.

HEAVY STORMS occurred in Iowa, southern Minnesota and Wisconsin on June 23 and 24 causing many washouts and the loss of many small dams and bridges. At Chalfield, Minn., six inches of rain in six hours are reported. In the vicinity of Dubuque, Ia., the storm was especially severe. Two inches of rain fell in two hours and in the whole county 25 or 35 bridges in all were washed away. The track of the Chicago, St. Paul & Kansas City was badly washed for 30 miles northwest of Dubuque. A tornado passed over Gallatin, Tenn., June 29, wrecking a church filled with a congregation and causing many serious injuries.

THE STONINGTON LINE STEAMER *Connecticut* blew off the cylinder head of her low-pressure engine at about 1:30 A. M., June 29, while on her way from Providence to New York. The passengers were transferred to the *Providence*, of the Fall River Line, which happened to be a short distance in the rear.

A DEFECTIVE FOUNDATION caused the wreck of a new business block, 140 × 60 ft. and 6 stories high, at Knoxville, Tenn., June 27. Fortunately no person was in the building when it fell.

THE BIENNIAL EXAMINATION AND TEST OF AUTOMATIC FREIGHT CAR COUPLERS prescribed by law in Massachusetts will be held on July 8 at the office of the Board of Railroad Commissioners, No. 20 Beacon St., Boston. Parties wishing to submit couplers for such an examination will make application to the board at 10 A. M. on the above date, and arrangements will be made for testing the couplers on the tracks of any railroad in Boston where the applicant may desire. The board will examine no couplers, however, except such as are in practical use on freight cars. The law prescribing this biennial test was passed in 1886, when the status of the automatic car coupler question was entirely different from what it is now. Just what useful purpose the official examination accomplishes at the present time is not apparent.

THE THIRD AVENUE road in New York City will begin to put in its cable system next month, and it is intended to have the whole line completed in less than one year.

THE STREET RAILWAYS OF SPOKANE FALLS, Wash., are the cause of much unpleasant feeling between the city and county officials. The company favored by the county sheriff laid a line in one of the streets which the mayor had torn out. The latter was arrested by the sheriff, but obtained bail and ordered the city police to arrest the sheriff, which was done. By order of the Superior Court, 250 deputy sheriffs have been sworn in, and the city now has the pleasure of seeing its two leading officials under arrest.

THE 7,300-TON CRUISER provided for in this year's Naval Appropriation bill will be designed for a commerce destroyer. She will have three screws, driven by three triple-expansion engines capable of giving a speed of 22 knots per hour. Her armament will consist of two 8-in. and fourteen 4-in. guns, with a number of rapid-fire and machine guns. The machinery for the vessel is now being designed at the Bureau of Steam Engineering under the direction of Chief Engineer MELVILLE.

THE CRUISER PHILADELPHIA, according to the official figures, made an average of 19.51 knots per hour for four hours in her recent trial trip. The contract called for an average speed of 19 knots, which gives the builders $102,400 in premiums. The dimensions of the vessel are: Length, 335 ft.; breadth, 48½ ft.; draught, 19 ft. 2½ ins.; tonnage, 4,324; maximum indicated horse power, 10,500. Her main battery will consist of 12 6-in. breech-loading rifles, and her secondary battery will consist of four 6-lb. rapid-fire guns, four 3-lb., two 1-lb., three 37-mm. guns and four Gatlings.

ROACH'S SHIPBUILDING AND ENGINEERING CO. has been incorporated in London for the purpose of buying the old Roach ship yards located at Chester, Pa., on the Delaware River, near Philadelphia. It is claimed that 75% of the entire tonnage of iron and steel vessels bearing the United States flag have been built at these works. Employment was given to about 1,500 hands in Chester, and 700 more were employed in the Morgan Iron Works in Philadelphia. The shipyards were purchased by John Roach in 1871. They occupy 27½ acres, and include piers, launches, ways, bulkheads, shops and machinery. The river frontage is over a quarter of a mile.

THE EXPENDITURE FOR NAVAL PURPOSES of the six great naval powers for 3 years from 1887 to 1890, were $3,902,005,635 or nearly $4,000,000,000 per annum. The expenditure is divided as follows: France, $1,270,514,205; Russia, $813,591,935; Great Britain, $618,933,380; Germany, $607,599,845; Austria, $337,971,000, and Italy, $313,395,270. France consequently spends annually upon her army and navy close upon $320,000,000, or more than England and Germany put together; Russia over $200,000,000, Great Britain and Germany over $150,000,000 each, Austria, nearly $85,000,000 and Italy, $77,500,000.

A SUMMARY OF VESSELS BUILT IN EUROPE DURING THE YEAR 1889 gives a total of 1,286,679 tons for British ports and 46,210 reported from Continental yards. Northeastern ports head the British list with 717,000 tons, the Clyde standing second with 335,201 tons, and Belfast next with 79,855 tons. The exports of engines and machinery were the largest ever recorded in the history of British commerce, namely, £15,254,658, against £12,932,625 in 1888, an increase of £2,322,033. Taking simply steam engines and parts thereof, the Argentine Republic was the largest customer last year, taking £610,200.

THE HENNEPIN CANAL report has been sent to the House by Capt. M. L. MARSHALL, the engineer. According to it the cost of the work, with 10 per cent. added for contingencies, is, for the main line, $5,067,562, and for the feeder line $1,838,398, making a total of $6,925,960. Capt. MARSHALL recommends that to secure the full benefits to be derived from the canal the Illinois & Michigan Canal should be enlarged to the capacity of the government canal, otherwise the proposed canal will be simply a local highway of importance to its immediate neighborhood, but regarded as a national highway of but comparatively small significance. Capt. MARSHALL, in conclusion, states that the canal cannot be of such value to commerce as it would be were the line throughout of greater capacity. It is evident, he says, that the canal should be built as a public necessity, either by the government or a private corporation.

The New Water-Works of the City of Chicago.

BY BERNHARD FEIND, M. AM. SOC. C. E., FIRST ASST. CITY ENGINEER.

(WITH INSET.)

The area of the city of Chicago was increased by annexation July 15, 1889, from 47 to 174 sq. miles; its population on that day rose at a bound from 900,000 to 1,110,000.

Its present population is estimated at 1,200,000; only a small proportion, located in the annexed districts, draw their water supply from other sources than Lake Michigan. This proportion will be decreased still further in the near future by the completion of the works, a description of which is given in this article.

The present water-works of the old city (with limits as before July 15, 1889) have an economical capacity of 125,000,000 galls. per day. The average pumped per day for the year 1889 has been 111,000,000, and the average per day per inhabitant supplied has been about 125 galls. This is rather high; but as the citizens demand the least possible amount of restriction on the supply for all purposes, and as the rate of growth, already quite high, bids fair to be higher still in the near future, the wisdom of providing early for a large increase in the capacity of the city water-works has been obvious for some years past.

The present supply is furnished through two parallel circular brick tunnels, one 5 ft. and the other 7 ft. in diameter, from a 10 ft. cast iron shaft, protected by a hollow pentagonal timber crib, placed in Lake Michigan in 26 ft. of water, at a distance of two miles from shore. Port-holes admit the water into the well of the crib; thence it passes through gates down the shaft, into which both tunnels open. The system owes its origin to the late E. S. Chesbrough, city engineer at that time.

There are two pumping stations, one close to shore in the northeast quarter, and the other one which is fed by a continuation of the 7 ft. tunnel under the land, in the southwest quarter of the old city. The tunnels as well as the pipe lines through out the old city intercommunicate.

The northern and southern suburbs annexed in 1889 have water-works of their own; it is likely, however, that the different systems in the enlarged city will eventually have close connection with each other. The portion annexed in the south has been supplied for some time through a 6 ft. circular brick tunnel from an intake one mile from the shore; for the water-works of the portion annexed in the north a similar intake and tunnel are being constructed in lieu of the short intake pipe in use at present.

The additions, in course of construction, to the water-works system of the old city consist of 4 miles of lake tunnel with three lake cribs and shafts, of about 1¾ miles of land tunnel with six shafts, and of two pumping stations, the larger one near the lake shore in the southeast quarter of the old city and the smaller one in the central portion of the same.

LAKE TUNNEL.

Although the land tunnel system as a whole was finished at a time when the lake tunnel had been extended to a distance of but 1,500 ft. from shore, the latter will be considered first.

The original plan contemplated a single circular brick tunnel 8 ft. in diameter, for the entire length of four miles, to be worked from three shafts, a permanent shore shaft at the foot of Peck Court, a temporary lake crib with a temporary lake shaft 2½ miles from shore, and a temporary lake crib protecting the permanent terminal lake shaft four miles from shore; the tunnel to run at right angles to the shore line, which here trends due north and south. It was intended that the permanent inlet, the 4-mile lake shaft, should be capped with a bell mouth casting, covered by a perforated cast-iron plate a little above lake bottom, thus forming a "submerged crib," and that the temporary crib should be removed.

The crib and the upper portion of the shaft at the 2½-mile point were to be removed, and the lower portion of the latter to be filled up after completion of the tunnel.

The intake was provided for at this long distance of 4 miles from shore in order to protect the new water supply more effectually than the old supply (from the 2-mile crib) against pollution by sewage from the Chicago River, which receives the larger portion of the sewage of the city, and has its ordinary outfall in the Illinois and Michigan Canal by means of the Bridgeport pumps (present capacity a little more 50,000 cu. ft. per minute), but is very apt to have its flow reversed towards the lake by freshets or by a sudden lowering of the lake level, or by a failure of the pumps.

The original plan was considerably modified in the course of construction.

An immense bed of quicksand was struck at the bottom of the Peck Court shaft, the shore shaft as contemplated at first, and the outflow from it caused the overlying strata to sink considerably. Thus the ground around the shaft was vitiated, and it was not deemed advisable to attempt to pierce it with the 8 ft. lake tunnel. The Park Row shaft was sunk and made the shore shaft, and the 8 ft. lake tunnel was driven from it heading toward the 4-mile lake terminal, as originally intended (off Peck Court), so that the tunnel now forms an angle of 86° 45' with the shore line to the north.

The 8 ft. tunnel had been extended to a point about 30 ft. beyond the shore line when plastic clay was met with in the roof.

The difficulty occasioned by the strong roof pressure was aggravated by a water-bearing vein, found simultaneously in the bottom. The ordinary methods of mining were discarded and a hydraulic shield was ordered. Two months later it was put into operation and work was carried on with it some time. It did not prove a success; owing to structural weakness, it soon lost shape and had to be stiffened by heavy iron posts; owing to the small diameter adopted for the pistons of the ten hydraulic pressure cylinders (3 ins.) an excessive pressure per unit was required, and 12,900 lbs. per sq. in. was frequently attained.

Of course the necessity, gradually developing, of such high pressures demanded frequent improvements in all the working parts, and consequently stoppages of work.

The plastic clay met with in the tunnel roof proved to be the bottom of the top stratum, in this place about 50 ft. thick, and the whole weight of this stratum was gradually brought to bear on the shield. A conical hole finally formed in the lake bottom just over the shield.

The plastic clay crowded in from the left-hand top corner only; the right-hand half of the top and middle was the toughest of hard-pan, and the bottom segment of the shield had to cut through coarse gravel bearing a great deal of water. The cutting edge of the bottom was once found to be bent double by two large cobble-stones in front.

A great deal of mining timber had been buried in the drift when the roof came down, and the shield had to make its way through this. It was very difficult to remove the heavy sticks from before the cutting shelves. After the contractor had spent a good deal of time and money on the shield without making any progress to speak of, he applied to the city authorities for permission to construct two 6-ft. tunnels in lieu of one 8-ft. tunnel. The permission was granted because careful borings had developed in the meanwhile the following facts:

The limestone bedrock under the lake is overlaid by a dangerous quicksand stratum, this by hard clay, the only stratum favorable for tunneling; this in turn by a water-bearing vein of thickness varying from nothing to 20 ft., above which spreads the great top stratum of plastic blue clay 30 ft. to 50 ft. thick, so dangerous on account of its swelling tendencies.

The favorable hard clay stratum is not thick enough, for a long distance from shore, to contain an 8 ft. tunnel. The stratification lines conform roughly with the dip of the lake bottom, therefore a tunnel, in order to be kept for the greater part of its cross section in the favorable hard clay stratum, must have westward or shore headings with up-hill grade and eastward or lake headings with horizontal grade, since we may not build on a down-hill grade with one water-bearing vein directly overhead and the possibility of an irruption from another one below. The tunnel eyes in the lake shafts must be placed at the lowest depth attainable with safety.

This principle has been adhered to so far.

The contractor built two 6-ft. tunnels from the Park Row shaft for a distance of 1,540 ft. almost entirely in soft clay and water-bearing material, on a grade practically horizontal, with the common mining implements and by the aid of generous quantities of timber.

As to alignment, the first detour was made around the soft spot where the shell of the shield lies buried, and a second one was preferred to a protracted struggle with another irruption of soft clay from the roof. Progress was necessarily slow; the cost to the contractor was considerable and work was stopped very soon after the following decision had been arrived at by the city authorities.

In order to make up for the loss of time caused by the quicksand in the Peck Court shaft and the soft material in the lake tunnel, by means of gaining the favorable hard clay stratum as soon as possible, another crib and shaft were interpolated ¼ mile from shore, on the lakeward side of the existing Government breakwater, bounding what forms the nucleus of Chicago's future outside harbor.

Considerable difficulty was experienced in sinking the cast iron shaft to the proper depth. The water-bearing vein, separating the soft clay from the hard clay, proved extremely vicious.

Its immense outflow caused a slow downward movement of the overlying soft clay stratum. This held the cast iron shaft in a relentless grip from which very heavy top loads were unable to disengage it, while on the other hand it served the stratum as a tool to crush all attempts at brickwork underpinning.

The outflow of water heavily charged with sand would persist in cutting its way down through the hard clay around the shaft and in issuing from under the shoe; and as long as the middle vein discharged its sand and gravel there was no hope of arresting the slow downward movement of the plastic clay which carried the shaft along with it.

The desired depth was gained at last by driving down gradually 2-in. oak sheet piling held by circular oak ribs inside the cast-iron shaft and by rapidly lining this sheeting with brickwork in quick-setting cement, after the soil had been removed down to the invert and after the invert had been built in.

From the shaft northward a lateral tunnel was driven from which four 6-ft. tunnels branched off, two westward on a rising grade to meet the two shore shaft headings, and two eastward on a horizontal grade towards the 2½-mile point.

The roofs of these tunnels ran throughout in the water-bearing vein revealed by the borings, and its outflow of sand and water at times proved a serious obstacle to progress. The westward rising headings in due time met the shore headings very nicely. The faces of the eastward headings are at a distance of 5,262 ft. from the shore line to-day, May 3, 1890.

The overhead water-bearing vein so often alluded to has at times of late proved comparatively harmless, so that excellent progress is very often made.

The tapping of this vein by the 2½-mile shaft, at an elevation much below that of the two tunnels, has, in all probability, contributed materially to the improvement of the tunnel faces.

It should be stated here that this water-bearing vein which divides the plastic from the hard clay appears to be continuous over the area covered by our new tunnel so far, and to have no connection whatever with storm or lake water, from the fact that the outflow from it into the shafts, when left undisturbed by pumping, never rose to an elevation higher than 20 ft. below datum, and from the further fact that frequent chemical analyses proved it to be slightly alkaline and of the same composition at different points under the land and under the lake.

2½-MILE CRIB AND SHAFT.

This is the only piece of work which is not paid for by units of measurement but by a bulk sum which includes the compensation for removal as well as for construction; the mode of construction, therefore, is made optional with the contractors, subject only to a general approval by the city authorities.

The design finally adopted is a hollow pentagonal timber structure. It was built with a water-tight timber bottom and sides water tight for some distance up, was floated into place and sunk in 37 ft. of water by being scuttled.

At an early period of the work an experiment had been made by the contractors with a crib in the form of a circular bottomless double steel shell to be carried to its destination on scows.

This structure was finished on shore, with 70 ft. outer and 31 ft. inner diameter, 54 ft. high, with radial brace systems in the annular part. It miscarried in the launch, so that the scows which were to lift it off the ways, by first being pumped full of water, then grappling the crib by special apparatus, and then being pumped empty again, could not get a proper hold of it. It was badly battered by the sea, and was finally taken apart in order to "save the pieces."

In sinking the cast-iron shaft inside the pentagonal timber crib, the often mentioned middle water-bearing vein caused difficulties similar in kind to those met with at the breakwater shaft, but greater in degree. They were overcome in that spot by sinking a water-tight wrought iron cylinder inside the bottom section of the cast iron ore. The bottom of the former was joined water tight to the hard clay by cement grouting, and the outflow was intercepted near its top by a 4-in. spout, so that brick work underpinning could be carried down to the desired depth.

The settlement of the upper stratum induced by the outflow of the middle vein, aided by the scour of the sea and the rocking of the tall crib in storms caused the crib with its superstructure to sink considerably, so that now the top of the crib proper at the weather corner is about 6 ft. lower than when the crib was placed.

The crib first settled altogether toward the weather corner, but lately reassumed a position nearer the vertical by settling more heavily on the lee side.

The movements of the crib were in part transferred to the upper portion of the shaft with which it had gradually obtained contact through dirt thrown into the well and through guide and brace timbers crossing the latter.

It probably was the antagonism between this movement in the upper part of the shaft and the one produced by the tight embrace of the slowly sinking plastic clay stratum in the lower part of the shaft which caused a rupture in the cast iron 4 ins. wide in the third and fourth sections from the bottom.

To make the shaft secure, after it had been extended to the proper depth, a wrought iron cylinder 30 ft. long was let into the cast iron shaft, resting on the wrought iron section at the foot and reaching up above the crack; the space between the cast and the wrought iron to be filled with Portland cement grout.

Another evil, consequent on the heavy settlement of the crib, was the far greater force that the waves exerted on the superstructure. On two different occasions the house was stripped of its outside planking by the sea, which then completely swept the floors, washing away or overturning everything, and driving the men into the lantern, where they suffered much and whence they were rescued with some difficulty. The second accident occurred during the notable storm of March 29, while the men were employed in grouting the space between the cast iron shaft and the wrought iron inlet. A good deal of time will be spent in rebuilding the structure in such a manner that it will be safe in future storms. There is hope that it will be feasible to drift single 8 ft. tunnels both eastward and westward from this crib, after the vitiated soil in the immediate vicinity shall have been pierced by double 6 ft. reaches.

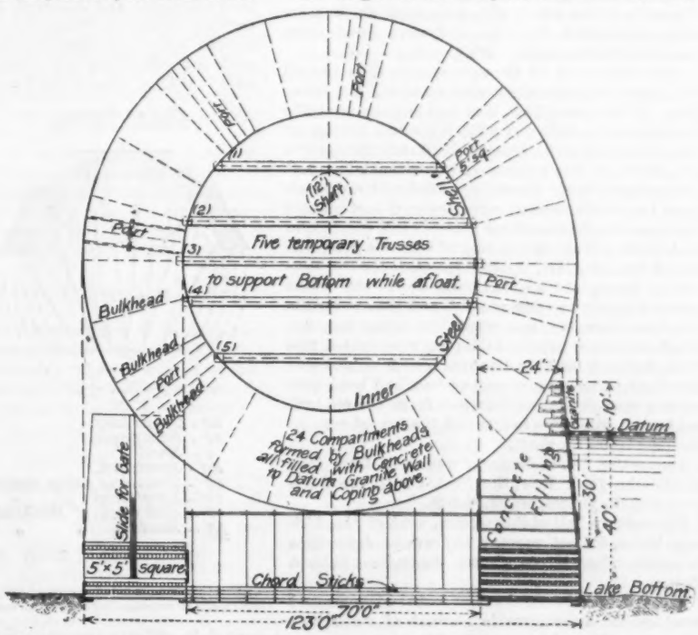
4-MILE CRIB.

The plan of a submerged crib was abandoned on account of the difficulty of locating it in dark weather and because of the fear of anchor ice.

The design adopted is a circular double steel shell of 123 ft. outside and 70 ft. inside diameter, stiffened by bulkheads traversing radially the annular space which is to be filled entirely by concrete. This shell rests on a polygonal timber grillage 15 ft. high, while a 2 ft. bottom extends under the 70 ft. well. The bottom section of the cast iron shaft is set water-tight into the well bottom, projecting below the latter. The well bottom was secured against buoyant effort during construction by five Howe trusses 20 ft. high. The well bottom, the trusses, and a few feet of grillage were built on ways; the balance was built on the water.

When the launch took place the structure weighed just 1,000 tons. As a matter of curiosity the correction of the calculation was tested by draught-marks put on before launching. They proved to be just awash immediately after the launch.

The weight of the complete crib with concrete filling and granite facings to 10 ft. above low water will be in the neighborhood of 26,000 tons.



PLAN AND VERTICAL SECTION OF 4-MILE INTAKE.

Six ports 5 ft. × 5 ft. through the bottom of the grillage, provided with gates and fish screens, will admit the water to the well which will contain the cast iron 10 ft.-inlet shaft with gates near the top. The body of the crib and a portion of the cast-iron shaft were finished in the harbor. Concrete filling was carried to the depth of 10 ft. in all compartments, while the crib was anchored to the lee side of the outer government breakwater, every foot of concrete filling increasing the draft by 18 ins.

Then, with a draft of 27 ft., and stiffened in every compartment near the top by platforms loaded with stone, it was towed into position and sunk in 30 ft. of water by being scuttled.

The filling with concrete was then resumed, and about one-half of the concrete filling, which will amount to a little more than 11,000 cu. yds. in all, had been placed when the approach of winter stopped the work.

The compartments in the lee quarter received the greatest weight, in order to counteract the tendency to tilt toward the weather quarter, which soon began to set in consequence of scour. The compartments on the weather quarter were loaded less heavily, but sufficiently for rigidity, and so were those at right angles to the line of greatest storms, while the intermediate compartments were left as they were. The crib has wintered exceedingly well, and must have settled very evenly, if at all, as far as can be judged by the eye alone. Work has not

yet been resumed, and measurements have not yet been taken.

LAND TUNNEL.

The chain of new land tunnels connects the shore shaft with the old 7 ft. land tunnel and with the two new pumping stations. Operations were carried on from six different shafts, including the shore shaft. The section connecting the shore shaft with the shaft at the junction with the old 7 ft. tunnel on Desplaines St. has a diameter of 7 ft. The section connecting this latter shaft with the shaft in front of the central pumping station on Harrison St. has a diameter of 6 ft. This section with its two end shafts was the one finished first. It and the Fourteenth St. shaft were built by the city's own men; while all the rest of the land tunnel work was done by the contractor for the lake tunnel. The new 6 ft. tunnel crossed over the old 7 ft. land tunnel, with but 6 ft. of soil between. It ran almost throughout in the upper plastic clay, and great caution, short lengths, and plenty of strong timbering were needed.

Excellent use was made in some places of short lengths of wrought iron shield in lieu of timbering. These fitted the soil closely, were made up in three segments, bolted together, and were lined afterwards with two rings of brickwork.

The connection of the new system with the old 7 ft. tunnel was made without pumping the latter dry. A 3 ft. tunnel 30 ft. long was built between the Desplaines St. shaft and a 3 ft. fire shaft sitting on the old 7 ft. tunnel. An iron diaphragm fitting this 3 ft. fire shaft was lowered down within a few feet of the tunnel roof. Small bags filled with quick-setting Louisville cement were lowered and pressed down on the circumference between the diaphragm and shaft, and above this ring of bags the shaft was closed by a plug, 7 ft. thick, of the same cement, lowered in boxes, which were tipped over. The water above the plug was pumped out, and the eye for the 3 ft. tunnel was cut, and when the latter was finished the ring of bags and the plug were drilled free from the shaft, and the diaphragm with its load was lifted out. The new tunnel system had been previously shut off against the water from the old tunnel by cast iron gates in front of the tunnel eyes in the Desplaines St. shaft.

The section 7 ft. in diameter was built from four shafts—the Park Row, the Peck Court, the Fifth Ave. and the Desplaines St. shafts.

The western half of this section, west of the Chicago River, did not present any serious difficulties in construction· it ran almost throughout in hard clay.

The portion between the river and the lake proved troublesome; a considerable amount of water, soft silt and swelling clay was met with.

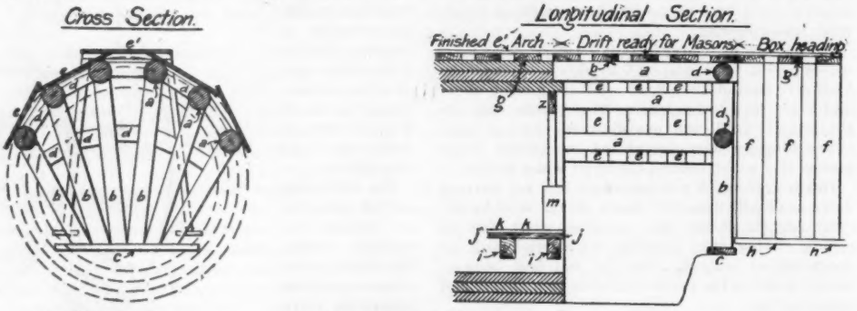
The difficulties encountered in sinking the Peck Court shaft have been hinted at. Originally intended to be the shore shaft for the lake tunnel, it was the first piece of work undertaken by the contractor for the lake tunnel. Sixteen feet above the proposed grade for the latter an immense bed of quicksand was tapped, and its outbreak destroyed the lower portion of the shaft, consisting of brickwork underpinning. This was removed, and the upper portion, consisting of a steel shell lined with 16 ins. of brickwork and resting on a steel shoe, was sunk low and added to on top. The friction of the plastic clay was overcome by working a heavy boring tool continuously around, and close to, the outside of the steel shell and introducing water into the holes. Later on a second shoe and shell were built in underneath the first shoe, and this lower shaft was forced down by hydraulic jacks which bore against the upper shaft. Fragments of limestone rock imbedded in the quicksand had to be blasted from under the edge of the lower shoe, and the enormous outflow from the quicksand bed, often amounting to 500 galls. per minute, caused the ground surrounding the shaft to sink about 6 ft.

This settlement at first extended only toward the lake; but when it began to spread toward the valuable buildings on Michigan Ave. it was thought advisable to abandon the attempt to reach bedrock with the shaft, because progress was so very slow and the outflow from the quicksand bed could not be stopped so long as the shaft was in motion. The shaft was, therefore, cut off, and closed by a strong invert 11 ft. above the bottom, and, in order not to defer the tunneling proper for an indefinite period, it was utilized as an immediate land tunnel shaft.

The Park Row shaft offered difficulties only from the pressure of the plastic clay on the shoe of its steel shell, and a top load of 250 tons of pig iron was found necessary to force the edge through the soft stratum into the hard clay, after which brickwork underpinning was built with ease. In the Fourteenth St. shaft, in front of the South Side pumping station, the same difficulties had to be contended with; but in this case, the shaft being without metal shell and shoe, the vicious lower portion of the plastic clay, about 16 ft. in thickness, was pierced successfully by timbering solidly in horizontal arches made of 10 × 12 in. sticks and afterward lined with brick.

The tunnel connecting the shore shaft with the principal or South Side pumping station is an 8-ft. tunnel at both ends, while the middle stretch is a double 6-ft. tunnel, the conditions of soil in this reach being about the same as those in the lake tunnel near shore.

A gentle transition from the single 8-ft. to the double 6-ft. reaches and *vice versa* was effected by a succession of changing elliptical cross-sections, carefully computed and designed for the volume and velocity of flow of the circular reaches. The term circular is not to be taken literally; the upper semicircle is divided from the lower one by a strip 2 ins. wide in the 8-ft. tunnel and 4 ins. wide in the 6-ft. tunnel, in order to give space for planks to support the centers for the top arch. These cross-sections give almost exactly the same volume of flow in the double 6-ft. as in the single 8-ft. tunnel, assuming the same velocity, slope and co-efficient n (= 0.015) of Kutter's formula for both.


Cross Section.
Longitudinal Section.
Finished Arch
Drift ready for Masons
Box heading
aa – Crown bars.
bb – Face props.
c – Shoe.
dd – Stretchers.
ee – Crosswise poling boards.
e'e' – Lengthwise " "
ff – Side trees of Boxheading.
gg – Head " " "
hh – Shoe of Boxheading.
ii – Floor joists.
jj – Floor.
m – Brick pier on which rib sits.
kk – Track.
z – Supporting rib put in by miners after centers have been struck.
0 1 2 3 4 5 6 Feet.

BOX-HEADING SYSTEM IN DRIFT WEST OF PECK COURT SHAFT.

Crownbars aa are withdrawn as soon as bottom end of poling board e is caught by masons. The two top crownbars are inserted into box-heading as soon as masons have finished and before anything else is done in new drift.

The heading from Peck Court shaft toward Park Row shaft ran into very bad soil soon and was abandoned, and after the completion of Park Row shaft the heading toward Peck Court shaft was drifted in the hard clay on a much lower grade, and connection was made by a "goose neck" (reversed curve in steep gradient) built under the shelter of the end of the old drift from Peck Court.

The box heading system of mining was followed for a considerable distance west from the Peck Court shaft, and a reversed curve was substituted for the straight alignment in order to avoid tunneling under some valuable residences. The first house met with west of Peck Court shaft settled considerably, and the precautions above mentioned were taken to avoid a repetition of damages to buildings.

PUMPING STATIONS.

Most of the foundation work of both stations was done by the city's own men.

The central station has two Allis triple expansion vertical pumping engines (see ENGINEERING NEWS, May 31, 1890), each of a capacity of 15,000,000 galls. per 24 hours. The foundations have been set, instead of upon piles as first designed, upon a system of sand piers 9 ft. × 4 ft. wide and 12 ft. deep, which were sunk into the plastic clay bottom. There is a battery of three boilers for each engine; they are built after "Murphy's Smokeless Furnace Patent." The excavation of the deep pit (36 ft. below street grade) in the plastic clay proved tedious and troublesome, requiring a great deal of stout bracing. There were three horizontal tiers of bracing, each arranged in the form of a grillage of 10 × 12 in. timbers with 8 ft. panels; these were connected by vertical and diagonal ties. There is no stand pipe; the pumps will deliver directly into 36 in. street mains. This station is designed in part to supply the newly annexed portions to the west, and one main will run untapped through the old city into this district. The buildings, machinery and one battery of boilers are practically completed; the west end of the boiler house and the second battery of boilers have not been put up yet on account of delay in perfecting the title of the city to that portion of its grounds. Pumping will be commenced very soon with one engine at a time; the water is to be drawn from the old 7-ft. tunnel through the 3-ft. connection with the Desplaines St. shaft.

The engine house of the South Side pumping station as now planned will have room for four engines of the same type as those at the central station; but only three engines have been contracted for at the present time, and the fourth engine foundation is not to be carried up to full height.

The engine foundations here rest on piles 30 ft. long, driven with a follower 23.5 ft. long from the bottom of the house foundation pit.

The house and chimney foundations of this, as well as of the Harrison St. station, rest on piles 5 ft. long. The length of all piles is designed to reach hard clay.

This pit, on account of its larger dimensions, required stronger bracing in the plastic clay than the pit at the central station; 3 tiers of horizontal 12 × 12 in. sticks were set in 7-ft. panels. In erecting the engine foundations here, as well as at Harrison St., the more important members of the pit bracing were not taken out, but built in, and after completion of the masonry and back filling were cut away to within one foot of the brick faces.

The engine and house foundations of this station are completed; the connections of the station with the tunnel system are being constructed: work on the buildings will soon begin.

ALIGNMENT AND LEVELS.

The alignment of the land tunnels was based on the carefully computed co-ordinates of a special network of surface points, connected by triangulation and traverse lines, the tunnel axes simply forming portions dropped below ground by means of the shafts. That portion of a surface line which could be dropped down a shaft to form the commencement or basis of the underground part varied from 3 ft. to 8 ft. in length, according to the inclination of the finished shaft, due to one-sided pressure of soil upon the shoe during sinking. The line was set out in the roof of the finished tunnel with the transit by tiny iron eye-bars, through the eyes of which a fine plumb cord or the hook of a plumb lamp could be passed. The alignment for a new length of tunnel was thrown forward by the inspectors, from two plumb lamps hung in the finished tunnel.

In the curved parts, templates, prepared under the direction of the engineer in charge, were used, and

short chords were established by transit in the roof on the heels of the masons.

The location of the lake shafts was given by triangulation from a shore base, with a point on the old water-works crib as apex of the basic triangle.

One end of the base is its intersection with the tunnel axis; here an observatory, 60 ft. high, is placed. It was made so high in order to overcome terrestrial curvature and refraction of light (amounting together to a trifle over 9 ft. for 4 miles) besides haziness and mirage in the lower atmospherical strata. A similar observatory, 20 ft. high, is placed at the other end of the base.

The instrument used for triangulation is a 10-in. repeating theodolite made by Heer & Seelig, of this city; it reads to single seconds by means of micrometer microscopes and has an object glass of 24 in. focus and 2 in. clear aperture and two interchangeable eye pieces with a magnifying power of 45 and 72 diameters, respectively. The cross-hairs are illumined through the horizontal axis.

A common transit with a reflector for illumining the cross-hairs attached to the object glass is used for alignment in the tunnels. The meetings of opposite alignments have been quite close; the largest deviation (on an alignment 3,000 ft. long from a 6 ft. base) was 3 in. For shorter alignments the meetings have been as close as ⅛ in. Two plummet-wells of 6 in. wrought iron pipes in the chain of land tunnels, and one such of 12-in. wrought iron pipes in the lake tunnel furnished an additional set of points common to the surface and the underground traverses.

The levels were established at the bottoms of the shafts by steel tapes hung plumb, and were carried forward by an ordinary engineer's level with reflector attachment, benches being left mainly in the tunnel roof. From the nearest bench the inspector transferred the proper grade to the face of each drift by means of a straight edge, spirit-level and rule. The levels at the meetings of opposite headings have always met within a few hundredths of a foot. The levels on the lake cribs were established by simultaneous observations on two hook gauges in calm water, one gauge, with known elevation of its zero, placed near shore; the other one on the crib.

BORINGS.

Worm or pod augers with gas-pipe rods were used. The turning, grinding and lifting apparatus was a simple contrivance worked by hand, consisting of derrick and winch, block and tackle, rams, clasps, pipe tongs and levers. Samples were taken at carefully measured depths by the foreman, as a rule every 6 in., except in the thick top stratum. They were labeled immediately, examined by the engineer in charge, and preserved. From them and the foreman's record the profiles were compiled. Wrought iron casings were driven in water-bearing soil. A water jet was employed to bore through quicksand. On the lake the derrick platform was set either upon piles or built out from the cribs. Preliminary borings were made from a platform rigged from the stern of a firmly-anchored tug. Several bore holes in the open lake will yet have to be made, and the derrick will be placed on a scow with a square opening. The top outer tube, to keep the lake water out, will be plugged below vessel draught depth when work ceases, and an insert tube reaching above water will be put in when work is resumed. A chisel drill was used for drilling about a dozen feet into rock to make sure it was bedrock.

PROGRESS.

Ground was broken for the Desplaines St. and Peck Court shafts, the first pieces of work undertaken late in December, 1887. Details of progress are given in the appended table.

The average daily advance of the lake tunnel for the last four months from the shore shaft eastward has been almost exactly 15 ft.; this gives a rate of 4,500 ft. per heading per year. If this rate is maintained the lake tunnel will be finished by Oct. 1, 1891, one year before the World's Fair opens. This is making a liberal allowance of time for the 4-mile shaft, which has yet to be sunk, and for preparations needed to begin tunneling in both directions from the 2½-mile shaft.

The control of the whole of the work on the part of the city authorities is exercised under the direction of the Mayor and Commissioner of Public Works by the City Engineer, Mr. Wm. R. Northway. The writer has had immediate charge of the work so far as it lay within the province of the civil engineer from the beginning up to July, 1889. Since then he has exercised a general supervision, and his former first assistant, Mr. Wm. A. Lydon, has had immediate charge. The superintendent of the work done by the city's own men has been Mr. Wm. Innes. Mr. Kayajiro Kobayashi, now in Tokio, Japan, has proved a valuable second assistant during the early period of the work. The general engineering plans and designs have been prepared in the City Engineer's office by Mr. Wm. Chase, and the architectural ones by Mr. John P. Hettinger, Architect.

The contractor is Mr. Andrew Onderdonk, formerly of New York, represented by Mr. S. G. Artingstall, late City Engineer of this city, consulting engineer. Mr. James Onderdonk, manager, and Mr. W. B. Vetterlein, superintendent of construction. The sub-contractors for the lake cribs and shafts are the Fitz Simons & Connell Co., of this city.

A force of masonry, mining, brick and cement inspectors, managed by Chief Inspector Mr. John E McMahon, formerly contractor for the old 7 ft. lake tunnel, is under the orders of the engineer in charge. All contract work which is paid for by unit of measurement is done under city inspection. The inspectors hand in reports according to a strict and comprehensive system immediately after shift is over; these reports are revised by the chief inspector and the engineer in charge and filed. The engineer in charge delivers full reports weekly, monthly and annually at the City Hall.

Cement tests as to tensile strength, fineness and weight are carried on and recorded regularly according to a strict system, no consignment of cement being used without having been tested and found good. The requirement for Utica black ball, the standard brand used, is 100 lbs. tensile strength after 7 days.

Only hand-made burnt brick are used in the tunnels.

The new works when completed in accordance with present plans will add 75,000,000 galls. per day to the water supply. The economical capacity of the new lake tunnel is 125,000,000 galls. per day. The work will cost from $2,000,000 to $2,500,000.

TABLES OF PROGRESS.

Land Tunnel.

Time.	10-ft. shaft.	6-ft. tunnel.	7-ft. tunnel.	8-ft. tunnel.
Jan. 1-June 36, 1888..	337.5 ft.	495 ft.	3,640 ft.	75 ft.
July 1-Dec. 31, 1888...	81 ft.	360 ft.	3,100 ft.	189 ft.
Jan. 1-June 30, 1889..	....	1,859 ft.	313 ft.	202 ft.
Total.....	418.5 ft.	2,714 ft.	7,653 ft.	466 ft.

Lake Tunnel.

Time.	10-ft. shaft.	6-ft. tunnel.	8-ft. tunnel.
July 1-Dec. 31, 1888..	.....	625 ft.	260 ft.
Jan. 1-June 30, 1889..	86 ft.	2,646 ft.	3 ft.
July 1-Dec. 31, 1889..	.....	3,912 ft.	.....
Jan. 1-April 30, 1890..	106 ft.	3,303 ft.	.....
Total.....	192 ft.	10,486 ft.	263 ft.

Best monthly average per heading for 1889...434 ft. 9 ins.
Best daily average per heading for 1889..... 21 ft. 2¼ ins.
Best progress in any one week for 1889.....136 ft. 1 in.
Best monthly average per heading for 1890...494 ft. 9 ins.
Best daily average per heading for 1890..... 20 ft. 10 ins.
Best progress in any one week for 1890 ... ...135 ft.
Best single day's work (April 17, 1890)..... 25 ft.

The Laws of Air Resistance.

BY PROF. H. ALLEN HAZEN.

The recent articles on this subject by Mr. O. T. CROSBY, as lately published in ENGINEERING NEWS, have been of the profoundest interest, as they indicate that by his experiments the usual law of resistance of the air varies directly with the velocity of the current rather than with the square of the velocity, The most careful experiments with whirling arms, by exposing plates to direct wind, and on locomotives with velocities running up to 40 miles per hour, have invariably shown the resistance to vary with V^2. It is difficult to understand how these later results have been so utterly different, but one or two points may be suggested which may partly, if not entirely, explain the anomaly. The theoretical formula for fluid resistance upon a flat plate, as given by Prof. MARVIN in Encyclopædia Britannica, is

$$R = f\,G\,S \times \frac{v^2}{2g}$$

In which, R = total resistance, expressed in pounds, due to an excess of pressure in front augmented by an increase of pressure produced by a partial vacuum in the rear; f = a coefficient to be determined by experiment; G = density of the fluid; S = surface of plate in square feet; V = relative velocity of fluid and plate in feet per second; g = force of gravity; f has been found about 1.8. Substituting in the above formula and using miles per hour; and p for total resistance in pounds, we have:

$$p = .005\,s\,V^2.$$

The only question that has been usually considered doubtful is that regarding the accuracy of the first two factors in the second member of this equation. The first factor has been variously determined from .003 to .005 [it has been determined as low as .0014.—ED.]; the first with very low velocities, less than 10 miles per hour, and by carrying the plate through the air; the second at higher velocities, and both by carrying the plate in still air and by allowing the wind to blow against the plate. The second factor has been found in some experiments with very short whirling arms and low velocities to vary with the perimeter of the plate, but this entirely disappears with longer arms or straight line motion and the only question now to be determined is the value of the coefficient. Perhaps some of the best experiments for determining this value were tried in France in 1886 by carrying flat boards on trains. The resulting formula in this case was for 44.5 miles per. hour, $p = .00535\,S\,V^2$.

Mr. CROSBY'S whirling experiments were made with an arm 5·5 ft. long. It is certain that most serious effects from centrifugal action would be set up by using such a short arm, and nothing satisfactory can be learned with arms less than 20 or 30 ft. long at velocities above 5 miles per hour. He seemed to find a remarkable coincidence between his results with the whirling arm and on a track two miles in circumference. In the latter case, however, the plate was very much larger, and there seems to be little doubt but that the total resistance was seriously modified by the surroundings of the plate, which does not seem to have had a free exposure—not a perfectly free exposure, but we do not see how the open surrounding cage could diminish air resistance. It is probable also that the manner of measuring the resistance had an important bearing upon the final result. It is very much to be hoped that these experiments will be repeated under varying conditions, for the question is of the greatest importance.

In computing the effective resisting surface in a train of cars, Mr. CROSBY seems to have included more or less skin friction. Now it has been found that this skin friction is exceedingly slight, and need hardly be counted; also, the front of a locomotive presents so many rounded surfaces that we cannot consider the area of a cross section of the resisting surface as the total surface exposed. The resistance of a sphere is only about half that of a flat surface having the area of a great circle of the sphere. Finally, the increased pressure from a partial vacuum at the rear of the plate would be largely broken up by the train behind.

From a study of this question it would seem probable that the total resisting surface in a train of cars, when reduced to a free flat plane, is not over 60 or 80 sq. ft., instead of the 390 sq. ft. estimated by Mr. CROSBY. [It strikes us this reasoning is sound in method, but goes too far in conclusions; 150 to 160 sq. ft. would probably be a fairer average.—ED.]

As to the method of determining the effective resistance against square plates by running cars down a grade without the plates and afterward with the plates, as suggested by some one in the last issue of the ENGINEERING NEWS, it must be said that this would be an exceedingly crude and unsatisfactory method of conducting such an experiment. It is a very simple matter to measure the total pressure upon a plate in straight line motion, though the problem becomes an exceedingly difficult one on a whirling arm, owing to the centrifugal effect. This whole problem can be completely and satisfactorily solved, either on the track used by Mr. CROSBY, or on a straightaway track for three miles, with a locomotive and two or three weighted cars in front. Several efforts made to obtain such conditions with railroads have failed, and only when some enterprising company sees the importance of this problem can we hope to gain a complete and satisfactory solution. There is no doubt that some one can be found to attack the problem if the means are provided.

Standard Mogul Locomotive, Chicago, Burlington & Quincy Railroad.

Upon our inset sheet last week were shown an elevation and plan of the standard Mogul locomotive in use on the Chicago, Burlington & Quincy Railroad. We present herewith several sectional views and end elevations of the same engine, from which, with the drawings in the last issue, the details of construction can be readily studied.

The company is now using locomotives of this type chiefly for passenger service, although some of the engines are used in freight service, and when the principal through passenger trains are fitted out with the engine it is expected to use it more largely in freight service.

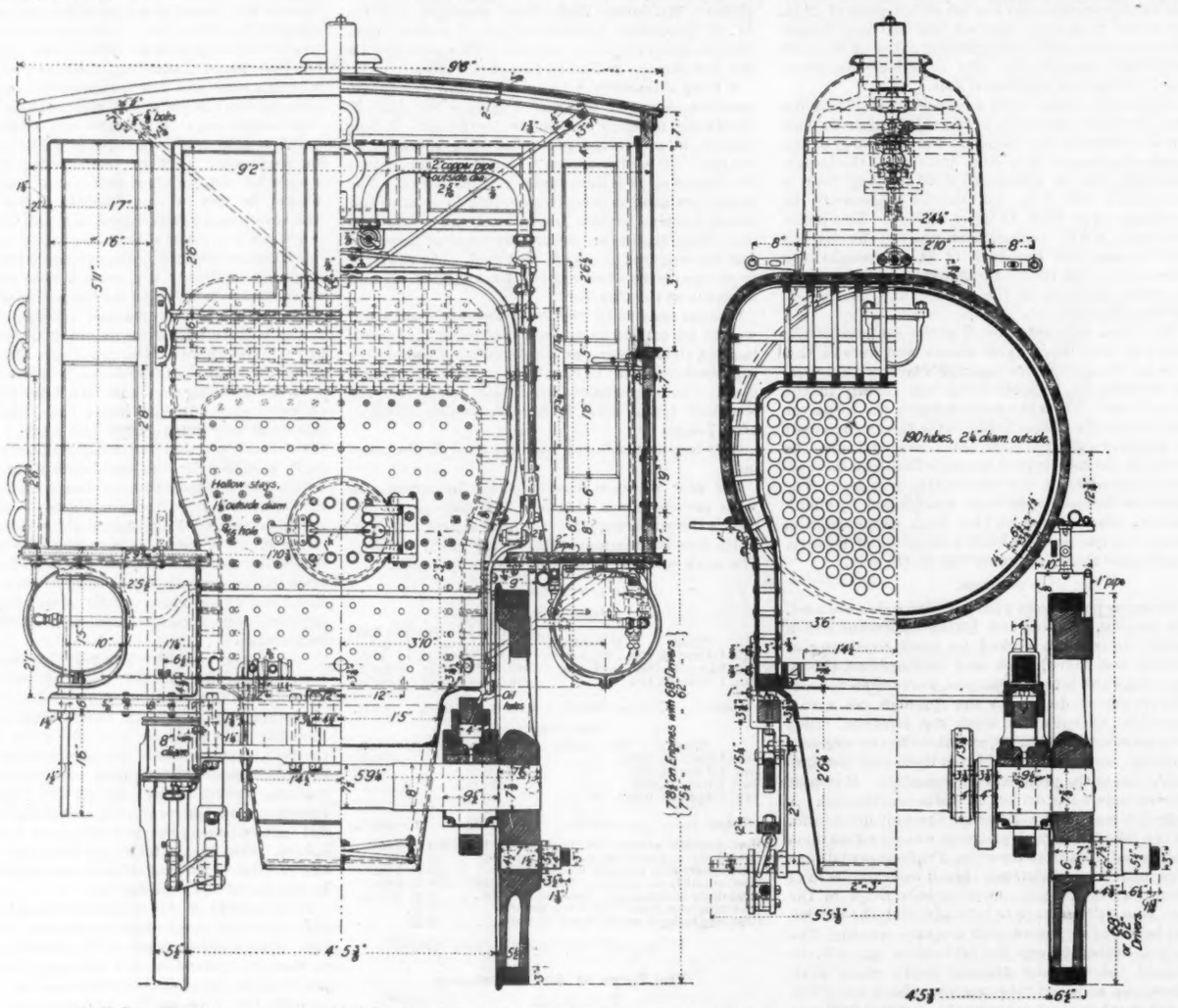
Boiler.

Maximum steam pressure	165 lbs.
Style	Straight, Belpaire fire box.
Smallest inside diam. of barrel	55 ins.
Steel sheets in barrel	⅝ in. thick.
Horizontal seams	Butt joint, double welt, triple riveted.
Circumferential seams	Lap joint, single "
Tubes	207, 2 ins. diam., 11 ft. 10 3-16 in. long.
Centers of tubes	2⅝ ins. back, 2¾ ins. front.
Fire box	48 ins. × 108 ins.
Water leg	3 ins. back and sides, 3½ ins. front.
Fire-box material	⅜-in. steel; back, sides and top, ½ in.
Tube sheets	½-in. steel.
Fire-box stays, radial	4-in. centers.
Grate	Rocking dump.
Grate surface	30 sq. ft.
Heating surface	Fire box, 130 sq. ft.; tubes, 1,287 sq. ft.
Center of boiler to top of rail	7 ft. 6 ins.
Top of rail to top of chimney	14 ft. 10 ins.
Weight of tender, loaded, coal and water	67,000 lbs.
Capacity, water	3,150 galls.
" coal	7 tons.

The locomotive of which the above dimensions are given is used on the Iowa lines of the C. B. & Q., and has 56-in. wheel centers. On the Illinois lines the same engine is given 62-in. centers. In both cases a 3-in. tire is used, thus making the drive-wheel diameter 62 ins. and 68 ins. It will be seen at once that with drivers of this size propelled by cylinders 19 × 24 ins. the engine is well adapted to fast runs with heavy trains. The engines now in use have given excellent satisfaction for both passenger and fast freight service, and for the latter service especially it is the belief of many well-informed railway mechanical engineers that engines of this type are to take the lead.

The speed at which the average freight trains run to-day is much higher than it was 20 years ago, and the use of air brakes and automatic couplers will tend to a further increase of speed. With the old type of freight engine with its small drivers, increasing the speed up to 35 or 40 miles per hour is very apt to result in a hot box with its accompanying delay, danger and annoyance. It is partly for this reason that the 6-wheel type of engine with either a pony or a 4-wheel truck is gradually gaining in popularity over the consolidation engine with its small wheel. Of course the latter is likely to retain its popularity for roads with heavy grades and it may be found that the demands of fast freight service will require the use of the consolidation type with larger drivers than have heretofore been fitted to it. The longer rigid wheel base of the consolidation engine, however, is somewhat against its use at high speeds.

The popularity of the mogul locomotive has been of late somewhat contested by the ten wheel type, which seems to have rapidly grown in favor.



Half Rear Elevation. Half Section through Cab and Rear Drivers. Half Section through Fire-Box. Half Section through Main Driver.

CLASS "H" LOCOMOTIVE. CHICAGO, BURLINGTON & QUINCY RAILROAD.

The following are some of the principal dimensions of the engine:

Total weight in working order	109,000 lbs.
Weight on driving wheels	91,900 lbs.
Wheel base	23 ft. 4 ins.
Driving wheel base	15 ft. 3 ins.
Total wheel base, engine and tender	48 ft.
Cylinder	19 × 24 ins.
Steam ports	1¼ × 17¼ ins.
Exhaust ports	3 × 17¼ ins.
Valve: Allen-Richardson balanced.	
Maximum travel of valve	5 in.
Cross-section of steam pipe	19⅝ sq. ins.

Wheels, etc.

Driving wheels, diam. outside of tire	62 ins.
Tires	3 ins.
Truck wheels, diam	36 ins.
Tires	3½ ins.
Driving axle journal	8 × 9½ ins.
Truck axle journal	5½ × 9 ins.
Main rod journal	5 × 5½ ins.
Parallel rod, front and back	4 × 3½ ins.
Parallel rod, middle rod	5¾ × 5 ins.

Whether the 4-wheel truck is safer than the pony truck in front of a locomotive, and whether it is enough safer to repay its extra cost are questions on which opinions are at variance. Actual tests and records of the service of each type are scarce, but it is to be hoped that those which exist may be unearthed by the committee of the Master Mechanics Association which has the matter in charge. In the engine illustrated the pony truck has given excellent satisfaction, and the wear on the flanges of the front drivers has been very small. Strong arguments may be advanced, both from theory and experience, to show that the pony truck is quite as perfect a safeguard as the four-wheel truck.

Among minor features of the locomotive deserving notice are the smokestack, which is of the flaring type now rapidly growing in favor. The form of the inner cone of the smokestack is evidently an improvement over the old styles which were de-

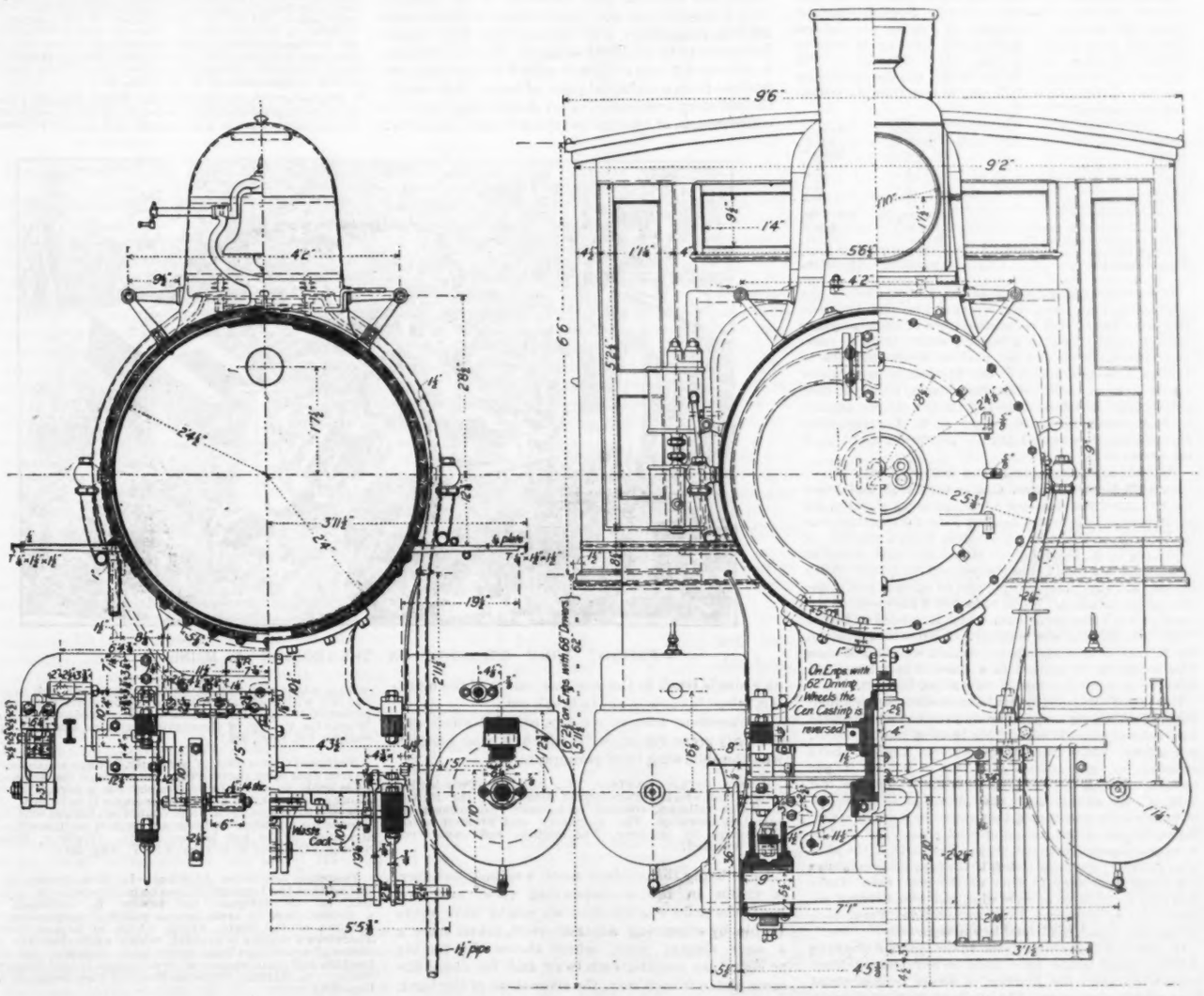
signed with no reference to facilitating the flow of the gases; yet there seems to be still room for improvement here. No hydraulic engineer would leave such a sharp projecting edge on an outlet pipe from a reservoir as that shown on this pipe, provided he cared to facilitate the flow of water from the reservoir. It would be a trivial extra expense to form a bell-shaped mouth on the lower end of this draft pipe, and there would almost certainly be more or less improvement in the draft.

The peculiar curve on the sand pipe to get it around the brake-head seems to be a rather needless following of old precedents, which certainly does not improve the appearance of the engine. The sudden bend would seem likely to cause clogging if the sand were not perfectly dry, and it checks the velocity of exit so that the sand strikes the wheel high in air and not the rail. At 10 miles per hour the sand will only fall some half inch before it strikes the wheel, then having some 2½ ins. yet to fall. To mention no other objection to this, it gives much better chance for the wind to scatter the sand. Moreover, in starting, the wheel has to advance more than a foot without sand before it strikes the sand. The English device of blowing sand by a steam jet directly under the wheel may or may not be generally advisable; but as near an approximation to this effect as is conveniently possible should be made.

The bracing of the push-bar to the front buffer beam looks like an excellent piece of construction, and strong enough to withstand all the strain that can come upon it.

The boiler is of the Belpaire type which finds such favor on Western roads. The 3-in. water space around the fire-box seems a little narrow for an engine of this size, although it is perhaps in accord with average practice. Ample provision is made for admitting air above the fire, 20 hollow stay bolts being used in the rear of the fire-box, each having a $\frac{5}{16}$ in. hole.

On the whole, the engine must be commended as a good and well-designed example of its class. There are plenty of roads which are trying to haul heavy freight and passenger traffic with superannuated 8-wheel engines whose master mechanics can study the accompanying drawings with much profit. They are made from the working drawings of the engine and can be relied on as correct. It should be remembered that the advantage of increased tractive power which the Mogul gives over the American type of engine is important not only for through freight and passenger trains, but also for heavy local trains making frequent stops.



Half Section back of Lifting Shaft. Half Section through Guides. Half Section through Smoke-Box and Front Truck. Half Front Elevation.

CLASS "H" LOCOMOTIVE, CHICAGO, BURLINGTON & QUINCY RAILROAD.

The Kinzua Viaduct, 1882.*

It has been said that more engineering skill was shown in avoiding the use of large bridges and viaducts on a certain line of railroad than could possibly have been shown in building them. Such was not the case with the Kinzua viaduct. A short branch line of the Erie R. R. runs from the main line at Bradford, Pa., to coal fields in McKean Co., Pa., and it became necessary to cross the Kinzua Creek, which flows through a deep valley some 300 ft. below the level of the surrounding country.

An attempt was made to cross this ravine by running down, crossing the creek at a low level and running up again on the other side. Even with two per cent. grades this lengthened the line some four miles, and it seemed better engineering to build a high-level viaduct than to avoid it.

An application was made by the late Gen. THOMAS L. KANE, of Pennsylvania, President of the branch line, to the engineering firm of Clarke, Reeves & Co., of Phœnixville, Pa., to ascertain the cost of a high-level viaduct, and whether it would be possible to get this viaduct ready for use in due season. It should be remembered that at that time, 1882, the highest viaduct in existence, the Verrugas viaduct, in Peru, was 252 ft. high, while this crossing required a viaduct over 300 ft. high.

MR. ADOLPHUS BONZANO, Mem. Am. Soc. C. E., of the Phœnix Bridge Co., told General Kane he could build him a viaduct 1,000 ft. high if he would furnish the money, and then made a preliminary sketch, embodying those proportions and details which had been previously worked out on smaller structures.

Before going farther, it may be well to give a brief sketch of the origin of American railroad viaducts. Viaducts of no great height had been made of cast-iron columns both in the United States and in Europe, when a new departure was made by the late C. SHALER SMITH, Mem. Am. Soc. C. E., by the use of girders of wood or iron, resting on columns of rolled iron sections, preferably the well-known Phœnix column. He generally placed these columns

* A paper, by THOS. C. CLARKE, read at the Cincinnati meeting of the American Society of Mechanical Engineers.

30 ft. apart in the direction of the line of railway, and gave them a very considerable batir, not less than 2 in. per ft. crosswise. They were braced together longitudinally by horizontal struts of wood, in order to avoid the difficulties arising from the expansion and contraction of continuous lines of iron which could have no sliding motion.

The author designed a viaduct approach for the proposed bridge across Blackwell's Island, N. Y., in 1870, fo the then chief engineer, I. D. COLEMAN, Mem. Am. Soc. C. E. Not wishing to use any perishable material like wood, the author avoided the difficulties arising from changes of length due to changes of temperature by simply leaving out the longitudinal struts and bracing of each alternate bay. This gave a series of braced towers 30 ft. long, connected by girders of the same length resting on their tops, and having a sliding motion at one end.

Afterward it was found expedient to lengthen these intermediate girder spans to the greatest length which could be transported whole from the shops to the site, say 60 ft. This is believed to be the historical origin of the well-known American railroad viaduct. English engineers have paid us the compliment of copying our viaducts in a late work on the Antifagasta Railway in Bolivia, South America, called the "Loa Viaduct." The section of the columns is the same, and the dimensions are very closely followed, as may be seen from the following comparison:

	Kinzua.	Loa.
Length	2,050 ft.	800 ft.
Height	302 "	330¼ "
Width of towers	38½ "	32 "
Connecting spans	61 "	80 "
Depth of girders	6 "	8 "
Width of platform	18 "	13 "
Gauge of railway	4 ft. 8½ in.	2 ft. 6 in.
Inclination of pier posts	1 in 6	1 in 6
Wind pressure per sq. ft.	30 lbs.	30 lbs.
Weight of iron	1,400 tons.	1,115 tons.
Time taken to erect	4 months.	8 months.

In a structure of the height of the Kinzua viaduct the question of wind pressure is a very serious one. American engineers had always recognized this in their practice, possibly from living in a country where cyclones rage. European engineers had not paid so much attention to this until the destruction of the Tay bridge in Scotland forced it upon their notice very strongly. After that catastrophe the British Board of Trade fixed the amount to be provided for at 56 lbs. per sq. ft. Corresponding French practice was 300 kilos. per *centimètre carré*, or 52 lbs. per sq. ft.

The then chief Engineer of the Erie Railway, Mr. O. CHANUTE, Mem. Am. Soc. C. E., considered that when the structure was unloaded a wind pressure of 50 lbs. per sq. ft. should be provided for, but when the structure was loaded from end to end with a freight train a pressure of 30 lbs. per sq. ft., including the area of the train, would be enough, as this would blow the train off the bridge. When loaded this wind pressure produces no upward pull at the base of the columns. When unloaded it produces an upward pull of 6 tons per column, which is resisted by anchor bolts, built into the pier masonry. The live load provided for is that of a consolidation engine, weighing 80 tons, with 44 tons on its drivers in a space of 14 ft. 9 ins., and followed by a uniform load of 1½ tons per lineal ft.

This viaduct was designed to be erected without scaffolding in as short a time as possible. It was erected in 4 months by a gang of about 40 men. This is at a rate of 500 ft. per month, while the South American viaduct, above referred to, was erected at a rate of but 100 ft. per month. The iron work was delivered at one end only of the ravine and slid down along a trough of timber to its proper pier, then raised by a crane standing on the end of the last completed span. The girders were raised complete in one piece. The parts of the piers were raised by gin-poles lashed to the tops of the columns, and raised from story to story as the pier rose. There was used about three miles of rope, and two hoisting engines built by Copeland & Bacon, of New York, each having four spools that could be run separately.

The joints of the columns were at the junction of struts. A better detail would have been to have placed these joints a foot above the junction of struts, which would have expedited erection. The whole erection was superintended by R. A. SIMMONS, superintendent of erection for the Phœnix Bridge Co. The cost of erection did not exceed $12 per ton.

As much discussion has gone on among engineers concerning the corrosion on the inside of Phœnix columns the following letter is of interest:

NEW YORK, March 31, 1890.

C. W. BUCKHOLZ, Chief Engineer, N. Y., L. E. & W. R. R.;

DEAR SIR: In accordance with your instructions I have cut from a column of Kinzua Viaduct a specimen, showing amount of corrosion which takes place on the inside of these columns.

In order that the specimen might show the worst conditions existing in the viaduct, one of the longest columns was selected and the disk taken from the under side. Any drip which might occur on the inside of the column would probably affect this point.

The specimen when taken from the column was entirely free from corrosion or any other sign of deterioration. The paint was in as good condition as when first put on, and where it was chipped off at the edges by the cutting tool, the iron showed a perfectly clean, new surface.

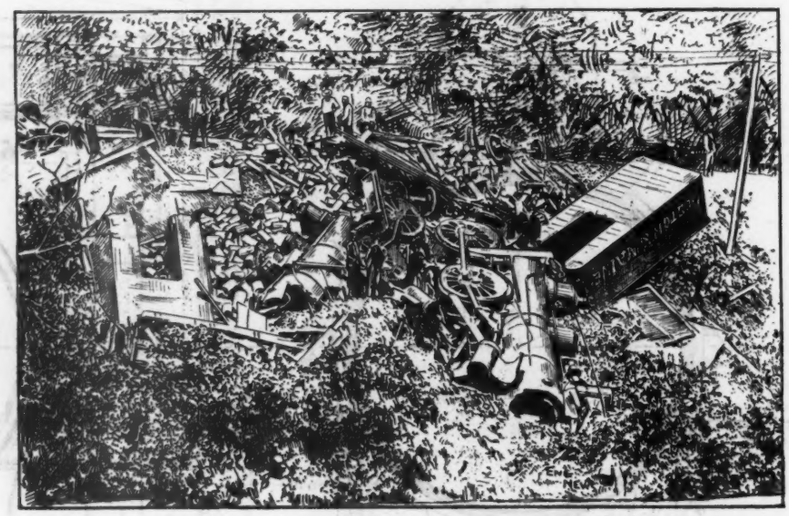
The specimen, 13¾ ins. in diameter and .969 ins. thick, was cut from the inside of the southwest column of the ninth bent from the east end of the viaduct, at a point about 3 ft. 6 ins. above the base of pedestal and about 12 ins. above the horizontal strut. The date of cutting was March 29, 1890. Respectfully yours,

HENRY B. SEAMAN.

The explanation of this is that the iron was protected by the paint from the action of the oxygen of the air. The paint itself was protected from the action of the sun, which on exterior surfaces first dries out the soil, and then, by causing a different rate of expansion and contraction between the paint and the iron, loosens the paint and leaves it to be washed off by rains.

Freight Train Collision on the Boston & Maine Railroad.

We illustrate in the accompanying view a somewhat curious freight collision which occurred near White River Junction, on Wednesday of last week, details and views of which have been sent us by a subscriber residing near the scene of the disaster, with a promptitude and completeness which we hope all our subscribers will imitate who may chance hereafter to be similarly situated. In this instance, however, the information is rather curious than important from a technical point of view. It is merely the old story over again, of lax dispatching, and as a consequence, of two trains trying to pass each other on a single track in the wee sma' hours of the morning, when laxness is apt to break out.



FREIGHT TRAIN COLLISION ON THE BOSTON & MAINE R R.

The accident was, as we say, a small affair and the only press report with which it was honored was the following brief paragraph:

WHITE RIVER JUNCTION, Vt., June 25.—Two loaded freight trains on the Passumpsic division of the Boston & Maine railroad, collided on a curve two miles from here this morning. The engineers and firemen saved themselves by jumping. The engines and cars were badly wrecked.

How badly the engines were wrecked, however, is visible in the accompanying view; and how badly the train was wrecked we might have made visible by engraving another view, taken from a a more distant point, which shows that for six or eight car lengths each way, and for about the same distance each way, the river slope of the bank was strewn with wrecks of cars.

The curve was convex toward the river, and the curious identity of the results with the two locomotives is faithfully reproduced in our engraving. Both had their truck and cylinders knocked off; both had their tender tanks knocked from the frame and turned bottom upward; both turned their wheels the same way; both lost their cabs. It is evident that one train was running slightly faster than the other, and whether by accident or otherwise, the engine which was running fastest gave slightly more punishment than it received. Had it seemed worth while to reproduce another view it would have shown a particularly bad group of wreckage on the slope at about the same distance (three car lengths) from the locomotives. Never was the law that like causes produce like effects more neatly illustrated. According to some theories which have been advanced in these columns (and which may be true), a like identity of effect should have resulted had one train been standing still and the other moving at 30 miles per hour, instead of both of them being in motion at about 15 miles per hour. It may be so; but we do not as yet believe it.

Legal Decisions of Interest to Engineers and Contractors.

Condemnation of Property under the Law of Eminent Domain.—Where there is no express provision in the statutes authorizing the taking of property already dedicated to a public use, the land held by a railroad corporation for a right of way and for depot purposes, when in actual use as such, cannot be condemned by a city for a public street. (City of Valparaiso v. Chicago & G. T. Ry. Co., Supreme Court of Indiana, 24 N. E. Rep., 249.)

Contracts with City Officers.—In bargaining for the city, one cannot be one of a party, acting as an employer, and become by the same bargain an employé. Contracts made by the city council with a lighting company will be void when one of the stockholders of the company is a member of the city council. The city will have to pay for the service rendered under the contract before the same has been declared void, as they have had the benefits and must do equity. (Grand Island Gas Co., v. West, Supreme Court of Nebraska, 45 N. W. Rep., 242.)

Power of City to Contract for Water Supply.—Unless there be express statutory power for so doing a city in Mississippi cannot make a permanent and exclusive contract with a water company to build water-works and supply the city with water. Authority implied from the general power of the charter is insufficient. (Greenville Water-Works Co. v. City, of Greenville, Supreme Court of Mississippi, 7 S. Rep., 408.)

Negligent Obstruction of Sidewalk.—When a man leaves an iron door open that covers a man-hole on the sidewalk, he is liable to one injured thereby, for a person passing along a sidewalk has a right to presume it to be safe. He is bound to no special care and cannot be charged with negligence for not being on his guard against an unlawful obstruction, or for not looking for it. (Wells v. Sibley, Supreme Court of New York, 9 N. Y., Sup. 343.)

Taxation for Street Lighting.—In New Jersey it is settled that the Legislature has no power either to establish, or to delegate the power to establish, a a district less in area than a political corporation or division of the State, within which to impose taxes. Therefore a statute is invalid, which authorizes the division of townships into street lamp districts, and the erection and maintenance of street-lamps in said districts. (State v. tp. Raritan, Supreme Court of New Jersey, 19 At. Rep. 610.)

Counter Claim on Contract.—Where a contract was entered into for the construction of a canal and water-supply, in sections and subdivisions at a fixed rate per cubic yard, the work to be approved by the engineer in charge of the water-supply and canal company, and 20% of the contractor's pay to be retained from the settlement of each section till the work was completed, and the contractor claiming to have completed the final section, and the company and its engineers claiming otherwise, the company putting on its own men and teams to finish the work. In a suit against the company by the contractor to recover his pay, the company cannot offset its claim for completing unfinished work, against the retained 20% earned, without showing the amount and value of the work both complete and incomplete according to the terms of the contract, nor can it be offset against the 20% reserve, an amount sufficient to re-construct work already accepted and estimated as completed, and of which 90% has been paid to the contractor by the company. (Price v. Kearney Canal & Water-Supply Co., Supreme Court of Nebraska, 45 N. W. Rep. 252.)

Liability of City for Defective Gutters.—In an action for damages against a city on account of the flowage of land from open gutters and the stoppage of a drain in a highway, the plaintiff did not distinctly show that the water would not have come down and flooded the plaintiff's land to the same extent as if there were no streets

there, and that the closing of the drain would not cause any larger flow of water, therefore, he cannot recover.
Collins v. City of Waltham, Supreme Judicial Court of Massachusetts, 24 N. E. Rep., 327.

Muncipal Corporations; Officers; Limitations.—Where a city treasurer, with the knowledge of the mayor, who has a supervisory power over the city's officer's, directs the tax collector to levy on and sell the property of a bank to make a tax levied on its stockholders, and the treasurer afterwards receives the tax knowing that it was made from a sale of the bank's property, the city is chargeable with knowledge of the unlawful proceedings of its officers, and is liable to the bank for the proceeds of the sale, without previous demand, in an action for money had and received. (Teall v. City of Syracuse, Court of Appeals of New York, Second Division, 24 N. E. Rep. 450.) (112M).

Eminent Domain; Public Use; Waiver.—Where the owner of land resists condemnation proceedings on the ground that the proposed railway is not a public use, her failure to appeal from a decision that the purpose was public, and her consent to the selection of commissioners, and litigation of questions of value, do not amount to a waiver of rights so as to preclude her from afterwards moving to set aside the entire proceedings as unauthorized by law, after the Court of Appeals has decided in another similar proceeding that the railway company in question is a mere private enterprise. (In re Niagara Falls & W. Ry. Co., Court of Appeals, of New York, 24 N. E. Rep. 452.) (108 M.)

Injunction in Regard to Railway Crossing.—A temporary injunction to enjoin the defendant from crossing complainant's road, will not be dissolved until final hearing on the merits; there being evidence to show that the desired crossing would be a dangerous one. (Appeal of Reynolds & F. C. Ry. Co., Supreme Court of Penn., 19 At. Rep. 674.)

The Railways of the World: 1884-1888.

We are indebted to the *Archiv fur Eisenbahnwesen* for the following account of the total railway construction from the close of 1884 to the close of 1888. According to that magazine the increase in the length of the different lines, during the four years, amounts to 63,941 miles, the total length being estimated at 355,302 miles, more than fourteen times the circumference of the earth, and half as far again as the mean distance of the moon from this planet.

America has contributed the greatest part of this new construction, having built 40,109 miles, principally in the United States. The increase in this country was 30,795 miles, in Canada 3,046 miles, in the Argentine Republic 1,961 miles, and in Brazil 1,749 miles.

Europe has the next greatest increase to show, 15,174 miles. Among the different countries, France and Germany take the lead with 2,515 and 2,514 miles respectively, while Austria with 2,273 miles, and Russia with 2,263 miles follow closely. Construction has been very active in Italy, where 1,420 miles, or 22.7% of the length in 1884, have been added. England makes a very small showing with 948 miles, or 5% increase. While the 612 miles in Spain, the 576 miles in Sweden and the 543 miles in Roumania are not great lengths compared with those of some other nations, yet they mark increases of 11.3, 14, and 54% in the systems of the respective countries. There has been absolutely no building whatever in Norway for some years, since the nature of the surface offers great obstacles to the development of a railroad system.

Of the Asiatic countries, India has furnished the greatest contribution to the new construction, 2,988 miles of track having been laid there. Moreover, the continuation of the Trans-Caspian Railway from Kisil Arwat to Samarkand has added 746 miles. Among the other countries of Asia, Japan shows considerable activity with her 456 miles, while elsewhere there has been no work of importance.

Algeria and Tunis, with their 568 miles of new track, head the African countries. No progress has been made in Egypt in actual construction, although there are plans drawn up for considerable new work.

Australia has built 2,893 miles during these four years, and as this is an increase in total mileage of 38.4%, it will be seen that railroad construction was most extensive, relatively speaking, on this one of the continents. Of the different colonies, Queensland laid 724 miles, New South Wales, 576 miles, South Australia, 565 miles, and Victoria, 504 miles.

With respect to the relation existing between the area of the country and the length of the railway system, it is interesting to note that Belgium has 264.3 miles of line to every 100 square miles of area, England (including Ireland) 133.3 miles, and Alsace and Lorraine 133 miles. Taking the German Empire as a whole, there are 100.3 miles of track to each 100 square miles of land, while France, with 95 miles, has nearly the same amount.

Sweden has 9.9 miles of railway for each 10,000 inhabitants, Switzerland has 6.2 miles, Denmark and Alsace 5.8 miles each and France 5.7 miles. Such a comparison is naturally more favorable to large, thinly-peopled countries than to those more populous, and is therefore of minor importance.

The number of locomotives employed on the various lines is given in the following table:

Country.	No. of miles of road.	No. of locomotives.	No. per mile.
Germany, 1888	24,332	12,811	0.523
England, 1887	19,587	15,552	0.781
France, 1887	20,826	9,747	0.46
Austria, 1886	14,295	4,610	0.32
Italy, 1887	7,309	2,256	0.30
Spain, 1887	5,855	1,616	0.27
Belgium, State R. R., 1886	1,970	1,792	0.91
other lines, 1886	890	540	0.59
Holland, 1887	1,367	057	0.42
Switzerland, 1887	1,747	650	0.37
European Russia, 1887	16,758	6,591	0.40
Sweden, 1885	4,152	717	0.18
Norway, 1886	971	139	0.14
United States, 1888	156,153	29,306	0.19
Brazil, State lines, 1887	1,251	224	0.18
British East India, 1886	13,350	3,234	0.24
New South Wales, 1887	1,088	426	0.21
Victoria, 1887	1,926	364	0.19
South Australia 1887	1,417	176	0.13
New Zealand, 1888	1,752	271	0.16
Algeria and Tunis, 1887	1,406	243	0.16
Natal, 1887	217	48	0.22

If we assume that for the 12,874 miles of additional railway which was in operation in Europe at the end of 1888, an additional locomotive was added for each 4.14 miles, the total number at the end of that time was about 60,785. In the same way we may consider that the 222,172 additional miles of track laid outside of Europe required a locomotive for every 5.18 miles, or 42,902 in all. Hence the total number of locomotives at the close of 1888 was about 103,700. If we assume that an engine has 300 horsepower, and that it can pull from 7 to 10 times as much on the smooth rails of a track as it would be possible to do on a good highway, we are safe in considering that these locomotives do an amount of work which would require 220,000,000 horses to perform.

The capitalization of the European railways is about $102,000 per mile, or $14,932,500,000 in all, while the value of the other railways of the world amounts to $13,641,600,000, or about $61,400 a mile. Hence the total capital invested in railways throughout the world may be estimated at $28,574,100,000.

The following table gives a view of the progress of building during the four years under consideration:

Country.	1884. Miles	1888. Miles	Country.	1884. Miles	1888. Miles
Prussia	13,572	15,120	Paraguay	45	94
Bavaria	3,119	3,324	Uruguay	292	399
Saxony	1,349	1,389	Chili	1,150	1,802
Wurtemburg	866	915	Peru	814	837
Baden	826	879	Bolivia	35	81
Alsace	816	905	Ecuador	43	127
Other German States	2,251	2,781	British Guiana	22	22
Austria	13,715	15,988	Jamaica, Barbadoes, Trinidad, Martinique	99	295
Great Britain and Ireland	18,872	19,920	British India	11,527	14,515
France	19,308	21,912	Ceylon	162	180
Russia	16,011	18,274	Asia Minor	231	409
Italy	6,254	7,675	Asiatic Russia	144	891
Belgium	2,713	3,000	Persia	...	11
Holland	1,650	1,864	Dutch India	715	763
Switzerland	1,774	1,848	Japan	265	721
Spain	5,306	6,008	Malay States	....	31
Portugal	949	1,189	China	7	86
Denmark	1,181	1,224	Cochin China	52	52
Norway	971	971	Egypt	932	932
Sweden	4,101	4,677	Algeria and Tunis	1,203	1,771
Servia	152	327	Cape Colony	1,545	1,776
Roumania	995	1,538	Natal	107	217
Turkey	807	1,024	South African Republic	....	50
Malta	....	7	Mauritius, Reunion, Senegal	108	416
United States	125,358	156,153	New Zealand	1,570	1,868
Canada	9,657	15,162	Victoria	1,603	2,167
Newfoundland	50	80	New South Wales	1,687	2,264
Mexico	3,231	4,177	South Australia	1,008	1,025
Central America	352	533	Queensland	1,207	1,930
Colombia	165	212	Tasmania	216	227
Cuba	904	904	West Australia	138	253
Venezuela	86	249			
Dominican Republic	50	71			
Porto Rico	11	11			
Brazil	3,709	5,549			
Argentine Republic	2,548	4,509			

As these figures are the results of careful work on the part of the computing bureau of the engineering force of the German Government, they may be accepted as approximately true.

PERSONALS.

Pres. CORBIN, of the Philadelphia & Reading R. R., has resigned his office.

Mr. A. A. MCLEOD, formerly Vice-President, has been chosen President.

Mr. F. S. DODDS has been appointed Superintendent of the Evansville & Terre Haute Ry.

Major J. W. JOHNSTON, Third Vice-President of the Richmond & Danville R. R., has resigned his position.

Mr. F. FLOYD WELD, M. Am. Soc. C. E. and City Engineer of Waterbury, Conn., died at that place on June 28, of typhoid fever.

Mr. J. D. LAYNG, General Manager of the N. Y., West Shore & B. R. R., will have charge of the traffic department of the Dunkirk & Allegheny Valley line.

Mr. A. B. STICKNEY has resigned the presidency of the Chicago, St. Paul & Kansas City Ry. His place will be taken by Mr. J. M. EGAN, the present General Manager.

Mr. L. K. LODGE has been appointed Superintendent of the Altoona Division of the Pennsylvania R. R., and Mr. R. J. HOLLIDAY to the same position on the Central Division.

Mr. W. A. VAUGHN, Superintendent of the Saginaw and Mackinaw division of the Michigan Central Ry., has resigned to accept a position with the East Tennessee, Virginia & Georgia Ry.

Mr. W. I. ALLEN has been appointed Assistant General Manager of the Rock Island Ry., with headquarters at Chicago. He was formerly Superintendent of the lines west of the Missouri River.

Vice-President F. C. YARNALL, of the Lehigh Coal & Navigation Co., died, June 26, at Overbrook, Pa. He was well known in railway circles, having been the President of several of the Lehigh branch lines.

Mr. EDWARD FRY died in Brooklyn, N. Y., June 26. He was mechanical engineer of the water-works of that city since 1878, having charge of all the pumping machinery. Before his connection with the water-works he was an engineer in the naval service.

Chief Engineer E. S. DELUCE, of the Navy, died at New Brighton, N. Y., June 24, at the age of 62 years. He was appointed third assistant engineer in 1849, second assistant in 1851, and first assistant in 1853. He became chief engineer in 1861, and had charge of the Boston and Brooklyn navy-yards during the war. He was placed on the retired list in 1878.

Col. C. F. WILLIAMS, formerly General Manager of the Little Rock & Memphis Ry., died June 20 at Surrounded Hill, Ark. He was a brother of E. H. WILLIAMS, of the Baldwin Locomotive Works and of Judge WILLIAMS, of Chicago, attorney for the Western Union Telegraph Co.

COL. JOHN MACLEOD has taken charge as General Manager of the construction of the Richmond, Nicholasville, Irvine & Beattyville R. R., extending from Versailles to Beattyville, Ky., 97 miles. His headquarters are at Louisville, where he continues his practice of consulting engineer. Col. MacLeod is also constructing the New Albany Belt R. R. at New Albany, Ind.

Mr. WILLARD SEARS died June 24 at Newton, Mass. He was the contractor for many of the depots stations and freight houses on the earlier New England railways and afterward built a number of large buildings in San Francisco. Mr. SEARS obtained the charter and called the first meeting to organize the Northern Pacific Ry., and was on the board of directors for five years.

Mr. ED. DICKINSON, General Manager of the Union Pacific Ry., has been appointed Superintendent of the Ohio lines of the Baltimore & Ohio R. R., succeeding Capt. W. W. PEABODY, who becomes Vice-President of the B. & O. Southwestern Ry. Mr. DICKINSON was born in 1850, and began his railway career at the age of 12 years. In his new position he will have charge of 575 miles of road.

MR. JOHN W. CLOUD, Secretary of the Master Car Builders' Association, has been appointed Western agent of the Westinghouse Air Brake Co. The announcement is made that he intends resigning the position of Secretary, but he has not done so yet. He is particularly well qualified for the office of Secretary of the M. C. B. Association, and will be a loss to it not easily made good when he closes his connnection with it.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers—Annual Convention.—The annual convention opened at Cresson, Pa., Thursday, June 12, continuing until Monday evening, June 16, and was in every way a brilliant success, upwards of 175 members and 61 accompanying ladies being in attendance. The majority of these were of course from Pennsylvania and the neighboring States, but a very good representation was present from all parts of the

country. The following is a nearly complete list of members in attendance. It doubtless includes some who had merely announced intention to be present, but were not, but on the other hand includes a considerable number who actually attended, but neglected to register.

LIST OF MEMBERS AND OTHERS IN ATTENDANCE AT THE CRESSON CONVENTION.

[*Ladies accompanying members are indicated by a star.]

From Massachusetts: JAS. B. FRANCIS, F. L. FULLER, D. FITZGERALD, R. A. HALE*, T. C. MCCOLLOM, J. R. RICHARDS*, M. M. TIDD**.

From Connecticut: D. S. BRINSMADE, J. W. BACON*, B. K. FIELD, C. A. FERRY*, M. MOULTON, T. H. MCKENZIE.

From other New England States: T. W. BALDWIN * *, J. P. SNOW.

From New York City and vicinity: W. H. BALDWIN *, O. F. BALSTON *, C. P. BASSETT, C. B. BRUSH, P. F. BRENDLINGER *, JOHN BOGART * * *, J. FOSTER CROWELL, F. COLLINGWOOD, W. R. COCK, H. S. DARWIN, S. B. DOWNES *, C. W. DURHAM *, J. F. FLAGG, A. P. FOLWELL, A. FTKLEY, J. W. FURGUSON, S. S. HAIGHT *, CLEMENS HERSHEL *, W. W. HEGEMAN, R. L. HOXIE *, W. J. HASKINS, GEO. R. HARDY *, C. R. JOHNSON, WALTER KATTE * *, A. R. LEEDS, H. C. MEYER, T. S. MILLER, T. H. MCCANN, L. MOSS *, F. O. NORTON, F. S. ODELL *, H. G. PROUT, H. B. SEAMAN, F. W. SKINNER, H. SKINNER, R. SHIRREFFS, JOHN THOMSON*, S. TOWLE**, L. L. TRITUS*, C. TOMKINS, G. H. THOMSON, A. W. TROTTER, J. G. VAN HORNE*, F. A. VELSCHOW, J. D. VAN BUREN*, W. H. WILEY, A. M. WELLINGTON, C. S. WARNER.

From New York State: W. F. BOOTH, E. B. GUTHRIE*, W. E. HOYT, R. H. MCKEE, P. C. RICKETTS.

From New Jersey (over 50 miles from New York): CLARK FISHER, W. A. BRACKENRIDGE.

From Philadelphia and vicinity: F. J. AMMEG, C. BLACKWELL, M. F. BONZANO*, W. H. BROWN, C.E. BILLEN, E. V. D'DURILLIERS, J. M. DAVIS, C. IVES*, W. JONES, W. LEWIS, D. J. LUCAS*, E. MITCHELL, H. G. MORRIS, E. O. MCLELLAN*, G. W. PARSONS, PERCIVAL ROBERTS, C. C. SCHNEIDER *, S. L. SMEDLEY.

From Pittsburg and Western, Pa.: M. J. BECKER * * *, A. BONZANO * * T. J. BRERETON, G. H. BROWN, WM. H. BURR, M. L. BYERS, A. COFFIN * *, A. DEMPSTER, JR., P. DIDIER, C. B. DUDLEY, T. N. ELY *, C.W. HAINES * *, A. C. HIPPEY, W. M. HUGHES *, A. E. HUNT * *, T. H. JOHNSON *, G. W. KITTREDGE, G. KAUFMAN, WM. METCALF, C. F. MOORE, E. NICHOLS, R. E. PETTIT, CHAS. PAINE, R. PITCAIRN, THOS. RODD *, W. P. SHINN *, H. SZLAPKA, F. L. SHEPPARD, R. H. SOULE, G. E. THACKRAY, E. B. TAYLOR *, M. W. THOMSON, M. TRUMP, JOS. WOOD, I. W. WALKER, V. WIERMAN.

From Baltimore: MENDEZ COHEN *, J. G. DAGRON, W. L. FERGUSON.

From Washington and the South Atlantic: C. M. BOLTON, J. B. DUNCKLEE*, B. R. GREEN, P. C. HAINS, D. E. MCCOMB, W. E. MERRILL*, JOS. NIMMO, JR., W. A. PRATT, J. E. WATKINS, H. M. WILSON.

From Tennessee and Kentucky: O. H. LANDRETH, H. I. MILLER*, G. B. NICHOLSON, J. A. PARTRIDGE, B. W. TAYLOR*.

From Ohio: W. A. AITKIN, L. ANDERSON, C. C. F. BENT, G. BOUSCAREN, L. E. CHAPIN, W. L. COWLES, W. C. CUSHING, H. T. EDDY, C. G. FORCE, K. E. HILGARD, T. D. LOVETT, F. C. OSBORN, F. C. WIER, BENJ. REECE.

From Indiana: F. G. DARLINGTON, E. A. HERMANN, F. M. WILDER.

From Illinois: O. CHANUTE, R. W. HUNT, C. J. MORSE, C. L. STOBEL, J. F. WALLACE *.

From Michigan: E. FISHER*, J. J. MCVEAN*.

From Iowa, Wisconsin and Minnesota: MONT'Y MEIP, W. A. PIKE, D. J. WHITTEMORE.

From Missouri: C. GAYLOR, J. B. JOHNSON, W. B. KNIGHT, I. A. SMITH.

From the Far West: ROBT. B. STANTON.

From Canada and Foreign Countries: W. A. BULLARD, C. E. GOAD.

The members from New York, Philadelphia and the Eastern States went by a special train running as a second section of the Chicago Limited, and four sleeping and parlor cars were well filled by them. A notable feature of the convention, however, was the number of members who kept arriving (and to some extent departing) by every train. There was but one drawback to the trip of the special train, the intense heat, which ran up to 94° in the dining car. Cresson, however, is almost at the summit of the railway pass through the Allegheny Mountains, some 2,150 ft. above the sea, we believe, and the temperature on reaching there, and throughout the convention, was thoroughly comfortable. The special train arrived at Cresson late in the afternoon, a large party from the west arriving soon after, and a considerable number being already there. The only business transacted were meetings of the rail and other committees, which were not made public.

The sessions began promptly at 10 A. M. on the following morning, and on motion Mr. WILLIAM METCALF, of Pittsburg, was chosen chairman of the convention, in accordance with the invariable custom of the Society, to choose its chairman from the most prominent of the members residing near the point of meeting. He made a thoroughly admirable chairman, as also a thoroughly admirable toast-master at the annual banquet, to which the evening of Friday (the second day) was devoted, and he will beyond question, in time, make an equally admirable president of the Society. The attendance at the opening session, and in fact at all the sessions, was very good.

The first paper presented was "The Designing and Erecting of the Oakley Arch," by J. FOSTER CROWELL, a full and admirable account of the construction of an arch of extreme skew, which, as we shall hereafter abstract it more fully, we will not attempt to abstract now. It led to a long discussion on the merits of various methods of constructing skew and false skew arches, which we shall abstract with the paper.

The next paper was one by F. W. WATKINS, "On a Method of Taking Cross-sections of Deep Rock Cuts by Triangulation," of which we shall give an abstract later. There was no discussion.

The third paper was a very elaborate one on "The Determination of Stresses in Elastic Systems by the Method of Least work," by Prof. WM. CAIN, which was not read, being of a highly scientific character and unsuitable for it, but submitted in MS. for examination and discussion by those interested.

The remainder of the forenoon session was occupied by the informal presentation of a most interesting diagram, submitted by Mr. DESMOND FITZGERALD, of the Boston Water-Works, which we shall shortly reproduce. It showed a remarkable constancy of ratio in the temperature of water in reservoirs at equal depths, regardless of the total depth and a very sudden and notable change from very warm to very cold water in passing from 20 ft. to 30 ft. of depth.

At the afternoon session the most notable feature was one of the most elaborate and complete which has ever been sent in for publication, one on "Irrigation in India," by H. M. WILSON. Mr. WILSON was sent to India by the U. S. Geological Survey to gather data on the subject, which he did with very notable success. It would be quite impossible to abstract the paper without taking a very large space to it. Some of the facts brought out were extremely interesting and novel, and all were well and concisely presented.

A discussion of some length on the "water cushion" used in India for waste weirs, and other special features of the kind, followed, which would be hardly intelligible without abstracting much of the original paper.

Mr. LINCOLN MOSS presented another careful and elaborate paper on some "Comparative Tests of an Electric Motor and a Steam Locomotive on the Manhattan (Elevated) Ry.," the comparison being much to the disadvantage of the motor used (the Daft). We shall hereafter republish the diagrams accompanying the paper.

The next papers were on "The Cheapest Railway in the World" by ARTHUR POST, an abstract of which will appear next week, and one on the "The Self-registry of Effects of Strain in Metals" by Prof. R. H. THURSTON, which was somewhat severely criticised as not being in fact especially novel, and seemingly with some justice, although it is needless to say that the paper was interesting and well presented.

At the evening session President WM. P. SHINN delivered the annual address, which we condense as follows, and with which we must close our report this week:

PRESIDENT'S ADDRESS.

By a constitutional mandate it is made the duty of the president of the society to deliver an address which shall set forth the progress made in engineering science during the preceding year. If in so doing I shall touch upon some facts which do not indicate progress, it may suggest to some of your minds how progress may be made.

BRIDGES.

Probably the most important engineering structure completed since the last convention is the Forth Bridge, with its two channel spans, 1,710 ft. in length. [Here followed a brief description of the bridge, with its tests and formal opening. See ENG. NEWS, Jan. 25, 1890, etc.] The total amount of steel used in the bridge proper and the approach viaduct is reported as 50,500 tons, and the total cost as about $15,500,000. This is truly a triumph of engineering.

The Merchants' Bridge across the Mississippi River at St. Louis was completed on Feb. 28, 1890. It is about 2,420 ft. in length, with three spans of about 525 ft. [See ENG. NEWS, Dec. 21, 1889.]

The Kentucky River Bridge, completed in August, 1889, is a cantilever, of interest both for length of span and rapidity of construction. The total length is 1,038 ft. The two steel towers are 551 ft. apart. The bridge was completed in six months from the date of starting work on the foundations. [See ENG. NEWS, April 5, 1890.]

The bridge over the Thames River, in Connecticut, built under supervision of Mr. ALFRED P. BOLLER, is remarkable for having the longest draw span in the world, 503 ft. in length. The entire length of the bridge is 1,423 ft. It was opened for traffic Oct. 10, 1889. [See ENG. NEWS, Oct. 12 and 19, 1889.]

The Coteau Bridge over the St. Lawrence River was opened for traffic early in April, 1890. The extreme length is 6,035 ft. It is a double triangular riveted lattice structure. The trusses were placed on the piers by means of scows, as in the erection of the Hawksbury bridge. [See ENG. NEWS, April 12, 1890.]

BRIDGES UNDER CONSTRUCTION.

The new Louisville and Jeffersonville bridge will surpass all previous records in length of truss spans. It will have two 550 ft., one 553 ft. and two 43-ft. spans. The total length will be 3,505 ft. The bridge over the Ohio River at Brunot's Island below Pittsburg, will have a 500-ft. channel span, which is to be floated into place on pontoons. The Memphis bridge, also well under way, will have one span of 791 ft. The estimated cost is $3,000,000. The Tower bridges under construction across the Thames, in London, is remarkable for the peculiarities in its design. It consists of two short spans, each 270 ft., and a middle span of 200 ft., resting, when in place, 29 ft. 6 ins. above high water, but divided in the center and hinged at the ends so that its two leaves may be raised to a perpendicular position, leaving an opening to the truss connecting the two towers to a height of 135 ft. above water level. [See ENG. NEWS, July 6, 1889.]

BRIDGES PROPOSED.

The North River Bridge when constructed, with its span of 3,200 ft., will restore to this country the prestige, which it enjoyed at the time of completion of the East River bridge, of having the longest span bridge in the world. It seems to be fairly in the way of accomplishment. [See ENG. NEWS, Jan. 14, 1888, *et seq.*]

The proposed bridge over the Mississippi, at New Orleans, as designed by Mr. E. L. Corthell, will have three distinct spans about 886 ft. in length and an elevation of 82 ft. above extreme high water. [See ENG. NEWS May 17, 1890.]

A bill has been introduced in Congress for the construction of a bridge across the Delaware River between Camden and Philadelphia. It is designed to be a suspension structure, with a total length of 4,440 ft. The most pretentious project is the proposed bridge across the English Channel, 24½ miles in length, with 118 piers and two abutment piers. The total weight of the whole bridge is estimated at 771,265 tons and the total cost at $172,000,000. [See ENG. NEWS, Nov. 2, 1889.]

BRIDGE FLOORS.

The accident known as the St. George Bridge Disaster, which happened on the evening of Feb. 27, 1889, is a case in point of the inefficiency of bridge floors. This bridge consisted of eight spans of 50 ft. each, composed of an iron truss upon which cross ties 8×12 ins. were laid, at least 8 ins. apart, and upon these ties the rails were spiked. At a point about 450 ft. from the end of the bridge the engineer noticed that the driver tire was broken; this resulted in the breaking of a side rod, so that on entering the bridge the whole train was derailed. There was a heavy wooden guard rail connecting the outer ends of the cross ties, but there were no guard rails proper close to the rails and no rerailing guards at the end of the bridge; the result was that the ties bunched together, leaving gaps which the wheels could not jump, thereby destroying one span of the bridge and causing two cars of the train to fall to the ground, and resulting in 13 deaths and 29 severe injuries, and a money loss of over $200,000. [See ENG. NEWS, Mar. 9, 1889].

On August 22, 1889, there occurred on the Knoxville Cumberland Gap & Louisville Ry., at Flat Creek, a somewhat similar accident known as the Flat Creek Disaster, two passenger cars were derailed in approaching the Flat Creek Trestle. It had a flooring of ordinary cross ties without any guard rails whatever; the ties were bunched, resulting in one passenger car falling to the ground, a vertical distance of about 18 ft. below the track; and out of the 34 passengers in that car, 29 were killed or seriously injured. [See ENG. NEWS, Aug. 31, 1889.]

In both of these cases had there been proper guards in the bridge approaches and proper guard rails on the bridge, and had the cross ties been laid not more than three to four inches apart, with spacing blocks between them to prevent bunching, it is not probable that either disaster would have occurred.

The subject of bridge floors is one which has long needed more careful attention, and it is gratifying to observe that the New York Central & Hudson River Ry. has awakened to its importance, and is now building or refitting many of its short span bridges with solid buckle-plate, or plate-iron floors, upon which the ballast is carried uninterruptedly. Every experienced engineer of maintenance of way knows how extremely difficult it is to secure and maintain such perfection of surface that the transitions from ballast to track on wooden bridge floors, and vice versa, shall be smooth and without shock. This difficulty is avoided by the character of floor adopted by the New York Central. Its advantage in case of derailment was shown on Nov. 12, 1889, when five cars of the westbound freight train left the rails and dragged across the new Erie Canal bridge at Rome, which had been provided with a floor of this character. The cars were scattered all over, two having their trucks pulled from under them; the ties and roadbed were torn up so that it looked as if the company had been trying to run one train on two tracks, but no damage was done to the bridge.

It is plain that true economy calls for construction of this character where it is possible, or where, as is being done by the Pennsylvania R. R. Co., it is not found practicable to replace the iron bridges with stone arches.

The most pernicious system in use is probably that in which the rails are spiked directly upon the stringers without the intervention of cross-ties. There are probably many hundreds, and it is possible thousands, of such bridges in this country, and every one of them, no matter how short the span, is a serious cause of danger.

RAILROADS.

The mileage of railroads in the United States at the end of 1889 was 161,382 miles. At the end of 1888 the rolling stock consisted of 29,398 locomotives, 27,712 cars in passenger service, and 1,005,116 freight cars. From the *Railroad Gazette's* report of the cars built in 1889, it is probable that not less than 1,100,000 freight cars are in use. Unfortunately, no national statistics of car mileage are collected, but ther

is reason to believe that, while commendable progress has been made in freight car capacity and in the hauling power of locomotives, the average movement of freight cars still remains in the vicinity of 25 miles per day, so so that on the average the freight cars of the United States stand still during 9 days for every day they are in motion. The efforts of the writer while in charge of the New York & New England R. R. showed conclusively that with a proper system of demurrage charges for delays in loading and unloading cars their average movement could be increased more than 50 per cent., and that, too, without any serious inconvenience to the patrons of the road.

About 63 per cent. more freight was moved in 1888 than in 1882, and during the same time the number of freight cars increased about 48 per cent.

In other departments of railroad economy improveme is manifest. In compound locomotives I apprehend tha the Baldwin 4-cylinder compound will be found super to the Webb compound, tested recently on the Pennsylvania. The Michigan Central 2-cylinder compou has drawn a train weighing 359 tons 228 miles with a con umption of a little over 7 tons of coal. Other en gin of the same type used 7 tons in running 152 miles. The trong locomotive has also given promise of economical results.

In appliances for increasing adhesion between the drive wheel and the rail, claims are made that material advantage ensues from the passage of an electrical current. The use of polygonal wheels, the tires of which were ground into facets of about ⅝-in. face, has resulted in total failure, as might well have been expected.

RAILWAY SAFETY APPLIANCES.

It is in this department that greatest progress has been made. ENGINEERING NEWS recently stated that during the winter of 1889-90 there were heated by steam from the locomotive all passenger trains on 8,465 miles, over half the cars on 10,912 miles, and from 10 to 50% on 17,516 miles; while roads having 10% or less of their cars so heated aggregated 50,550 miles. Experiments on the New York & New England Ry., while under the writer's supervision in 1888-89, showed that the heating of passenger cars by steam from the locomotives was not only practicable, but economical. Occasional car-stove accidents, as, for instance, 3 in a single week in January last, emphasize the need of this reform.

In lighting cars still more progress has been made, the kerosene lamp giving way to compressed gas. The Pintsch system, which uses compressed oil gas, seems to have a fairly well earned lead. In Europe over 30,000 cars are now lit by this system, and arrangements have been made for its use on an aggregate of over 35,000 miles of railway in this country during the present year.

In power brakes for freight cars a great advance has been made. The Westinghouse Air Brake Company reports 101,576 freight cars equipped with its brake at the beginning of 1890, or about one-tenth the freight car equipment of the country.

In 1888, after a somewhat exhaustive series of experiments by a committee of which the writer was chairman had demonstrated the actual superiority of vertical hook couplers over all others, the Master Car Builders adopted as their standard the vertical hook coupler of the Janney type. A statement in ENGINEERING NEWS of Dec. 21, 1889, shows 56,050 freight cars equipped with M. C. B couplers. The result of experience on the A., T. & S. F. R. R. shows that the M.C.B. coupler will more than pay for itself in the decrease of losses resulting from breakage of trains and damages to employés. The record of Janney couplers as given in ENGINEERING NEWS of Feb. 15, 1890, appears to show that they stand the shocks of service quite as well as couplers of any other type. It appears safe to say that within the present decade all freight cars will be equipped with automatic couplers.

In this connection it is well to refer to the Westinghouse friction buffer as an additional safeguard. This device has shown excellent results under severe tests. It seems clear that with automatic brakes, automatic couplers and such buffers it will be possible and safe to very materially increase (perhaps double) the average speed of freight trains.

The subject of safety signals is one of growing importance. The block system was long since adopted by the leading trunk line roads, but such accidents as that on the Pennsylvania R. R., near Jersey City, some years ago, show that something else is needed, and automatic electric signals appear to answer the purpose. The writer has had 3 years' knowledge of their use on 12 miles of the road under his charge without a recorded failure. A class of signals which should come into general use even on roads of little traffic is a mechanical signal set at a sufficient distance from each switch or station to enable an approaching train to stop before reaching it. [The writer then discussed statistics of railway accidents, quoting principally from ENGINEERING NEWS of June 7, and followed this with some words as to the importance of having trains on time, saying: "It is my conviction that the regularity and promptness of trains upon many of our leading railway lines are not as satisfactory to-day as they were 20 years ago.]

In the line of new railway construction the notable "Two Americas" project, chimerical as it may seem, is probably one on which construction will begin at an early day.

[The address than took up the subject of ship railways and canals, chronicling the abandonment of Capt. Ead's Tehuantepec project, and the progress on the Chignecto line in Nova Scotia, the failure of the Panama Canal and progress on the American Nicaragua Canal under Chief Engineer MENOCAL. The Eiffel tower was also referred to. See ENG. NEWS, June 8, 1889.]

ELECTRICAL ENGINEERING.

In no other branch of the profession have as great strides been made. The price of gas which in 1877, for 290 cities, averaged $3.15, had, in 1887, fallen to $2.00 per M. ft. On May 1, according to *Electrical Power*, there were 240 electrical street railways in operation and under construction, all built since 1886. In electrical welding great progress has been made. In experiments made at Malden, in 1889, to weld a 2 in. bar of wrought iron, the entire current from a 16 H. P. dynamo occupied 80 seconds in heating to a welding temperature, and 5 seconds in making the weld. [See ENG. NEWS, Jan. 18, 1890.]

WATER POWER.

The greatest advance in this respect which is now under consideration is the utilization of the power of the Niagara River. [See ENGINEERING NEWS, May 17, 24, 1890.]

SEWERAGE.

One of the most radical improvements which has been made in this regard was the construction of the Boston system of sewerage, with which most of you are familiar. Strenuous efforts are being made to use sewage as a fertilizer, or in some way dispose of it without polluting water-courses. The study of this subject is well worth the attention of the profession.

One of the greatest undertakings of modern times is the drainage of the Valley of Mexico. [See ENGINEERING NEWS, April 5, 12, 1890.]

COMMON ROADS.

Certainly no worse roads can be found in any civilized country than in ours. Legislation for the improvement of highways has been enacted or recommended in Massachusetts, Pennsylvania, New Jersey and New York. Prof. J. W. JENKS, in discussing the roads of Illinois, claims that a system of good roads would add $116,000,000 to the value of Illinois farms. Probably there is no one subject in this country offering opportunities for greater improvement than that of common roads.

POETSCH FREEZING PROCESS.

[The writer described this quite fully. See ENG. NEWS, Aug. 3, 1889.]

METALLURGY.

Within 10 years the output of a blast furnace of 20 ft. bosh has been increased from 100 tons to 325 tons per 24 hours. The production of pig iron is increased from 2,301,215 gross tons in 1878 to 7,603,642 gross tons in 1889, an increase of 230 per cent. While the production of the United States in 1878 was only 36 per cent. of that of Great Britain, in 1889 it equaled 92 per cent. of the British output. The manufacture of spirally welded steel tubes and the production of aluminum on a large scale at a moderate cost effected by the Pittsburg Reduction Co. are among important achievements of the past year.

FAILURE OF DAMS.

The failure of the South Fork Dam undoubtedly shows the danger of a too contracted spill-way. [ENGINEERING NEWS, June 8, 15, 1889.] A similar cause brought about the failure of the Walnut Grove Dam in Arizona. [See ENGINEERING NEWS, March 1, 1890, *et seq.*]

ANTIQUITY OF THE ENGINEERING PROFESSION.

At the annual dinner of the Boston Society of Civil Engineers, early in 1889, at which the writer represented this society, I was struck with the remark made by President ELIOT, of Harvard, that the profession of the engineer is the oldest known to history. A little investigation shows this to be true, as long before either law or medicine became a science, and when the priesthood was but a guild of charlatans, man was obliged to wrestle with the facts of nature and with the conditions in which he found material things. We have long been accustomed to refer to the Roman aqueducts as specimens of ancient engineering, and they are certainly worthy of consideration. A treatise by Consul SEXTUS JULIUS FONTINIUS, written about A. D. 50, stated that there were then aqueducts bringing water to the city of Rome with an aggregate capacity of 28,000,000 cu. ft. per day. One of these aqueducts was 63 miles long, 6½ miles of which were on arches, some of them over 100 ft. high. The aqueduct which supplied ancient Carthage is stated to have been 70 miles long, and to have had one arcade consisting of 1,000 arches, some of them 100 ft. high. It is stated, however, that aqueducts in Peru, constructed in the time of the Incas, far exceeded in length or capacity any other aqueducts of ancient or modern times, some of them being constructed to bring water for irrigation from the mountains several hundred miles off. The practice of medicine probably first received the character of a science from the time of HIPPOCRATES, who was born in 460 B. C., for although physicians are occasionally referred to as disciples of ESCULAPIUS, he is believed to have been rather of the nature of what would now be termed a quack. The Roman civil law, to which all our laws refer, was first codified by the Emperor JUSTINIAN, and as Rome was founded in 535 B. C., Roman law cannot go back to an earlier date. Recent explorations in Egypt, a description of which is given by Miss AMELIA B. EDWARDS in an article upon the ancient Egyptian city Bubastis, show that in the time of MENA, about 5,000 B. C., a dike or dam was constructed which turned the course of the whole river Nile into a location several miles at the most distant point from its former location, thus showing that at that remote period engineering works were undertaken of a magnitude which finds no parallel in modern times.

ENGINEERING SCHOOLS.

We apply the term engineer alike to the man who designs and the man who operates the engine, and worse than that, we use the term "Civil Engineer" as a degree conferred by colleges and engineering schools as unmeasuring in its application in many instances as the LL. D. bestowed by Harvard without discrimination upon the Governors of Massachusettts. The qualifications required for membership in this society should be the qualifications entitling any one to use the title "Civil Engineer."

The curriculum of our engineering schools should embrace the science of accounts and the study of the law of contracts to such an extent as to enable a young engineer to keep proper accounts of his expenditures, and to know when he was transgressing the well-known principles of law. In a recent case a young engineer inspected the lumber for large railroad shops at the point of delivery and respected a considerable amount. His company was obliged to pay for it all, however, inasmuch as the contract specified its delivery at the mill where sawed, and by the law of contracts inspection must be made at the point of delivery, if at all. Engineers are frequently so situated that, like the captain of a ship, they must for the time being be a law unto themselves.

[The writer then referred to the foreign tour made by American engineers last year and to the visit to this country next fall of the Iron and Steel Institutes of Great Britain and Germany.]

EXPERT TESTIMONY.

I indorse what was so well and wisely said by Past-President WORTHEN in regard to the testimony of experts. Nothing can be more unseemly than to see two eminent members of any profession, each striving to earn his fee by stating such facts or giving such opinions only as make for the side by which he is retained. The differences of opinion which naturally must exist are thereby stimulated and intensified until all respect for scientific opinion is lost by the laymen who have no knowledge of the subject. It has long been my opinion that the expert witness should be called by the court and that he should be allowed to state facts and opinions freed from the trammels of the "*Suppressio Veri*" so often employed by the attorneys on either side. It might result in some of my professional brethren receiving less fees, but it would be to the benefit of the profession and the cause of justice.

I would again call the attention of our members to the importance of care and accuracy in all their acts and statements. The engineer, of all men, cannot afford to be careless, to make loose or unauthorized statements, to give opinions for which he has no data, or to do any act, even of so unimportant a nature as sending in a ballot to this society without carefully considering and complying with all the necessary forms, and being sure of his facts. Great odium has been brought upon the profession from the fact that, from one cause or another, the estimate of the engineer is too generally below the resulting cost—often far below—until capitalists when shown the anticipated cost of a work in which they are asked to invest will often say, "Oh! that is only an engineer's estimate!" It is on record that the actual cost of the original Croton aqueduct, when completed for use, was less than one per cent. in excess of the original estimate made by that careful engineer, our late esteemed member JOHN B. JERVIS.

By a careful study of all the facts, it is possible to make our estimates bear a much more satisfactory relation to the cost than, in large works especially, has generally been the case.

This principle should not be confined to matters of cost—in questions of any kind upon which an opinion is to be given, or a statement is to be made, let it be based upon the best possible ascertainment of the facts—for the statement of the civil engineer should "import absolute verity!"

The society is growing, its influence is widening, and its power increasing, but whether or not for good must depend upon the interest taken by its members.

The life-blood of the society is its papers and discussions. When interesting papers flow in, interest is stimulated, discussions follow, and by the interchange of opinions and experience the membership is benefited.

Most engineers have some experiences which are unique; they should be reported. Papers need not necessarily belong, or cover the whole of a subject, and every member should contribute what he can to the general fund of knowledge and experience, and thus the society can be made to expand in membership, in influence and in value, until it shall embrace all the members of our noble profession on this continent, with a few from the older hemisphere, and it will become in fact what it has long been in name, THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

[*To be continued.*]

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.

Vol. XXIV. Saturday, July 5, 1890.

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GEO. H. FROST.....BUSINESS MANAGER

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COMING TECHNICAL MEETINGS.

Civil Engineers' Society, St. Paul, Minn.—Next meeting, July 7. Secy., Geo. L. Wilson, City Hall.

Engineers' Club of Kansas City, Mo.—Next meeting, July 7. Secy., Kenneth Allen, 200 Baird Building.

Civil Engineers' Club, Cleveland, O.—Next meeting, July 7. Secy., C. O. Palmer, 22 Cedar Ave.

Civil Engineers' Association of Kansas, Wichita Kan.—Next meeting, July 9. Secy., J. C. Herring, Wichita.

Engineering Association of the Southwest, Nashville, Tenn.—Next meeting, July 10. Secy., Olin H. Landreth, Vanderbilt University.

Engineers' Society of Western Pennsylvania.—Next meeting, July 15. Secy., S. M. Wickersham, Pittsburg, Pa.

American Society of Civil Engineers, New York.—Next meeting, July 16. Secy., John Bogart, 127 E. 23d St.

Boston Society of Civil Engineers. — Next meeting, July 16. Secy., S. E. Tinkham, City Hall.

Engineers' Club of St. Louis, Mo.—Next meeting, July 16. Secy., W. H. Bryan, 30 South 7th St.

New York Railway Club.—Next meeting, July 17. Rooms, 113 Liberty St.

Engineers' Club of Philadelphia, Pa.—Next meeting, July 19. Secy., Howard Murphy, 1122 Girard St.

Association of Civil Engineers, Dallas, Tex.—Next meeting, Aug. 1. Secy., E. K. Smoot, Elm and Austin Sts.

Western Society of Engineers, Chicago, Ill.—Next meeting, Aug. 5. Secy., J. W. Weston, 230 La Salle St.

American Society of Railway Superintendents, Boston, Mass.—Annual meeting at New York on the day preceding the fall meeting of the General Time Convention. Secy., C. A. Hammond, 350 Atlantic Ave.

THE index for the volume just closed could not be conveniently prepared to appear in this issue, owing to the interference of the glorious Fourth with the routine of the printing office. It will appear with our next issue.

THE convention of the American Society of Civil Engineers at Cresson, Pa., which began on Thursday of last week and ended the following Monday, with two further days to go and come for most of the members, was one of the most successful and enjoyable in the annals of the Society, as it was also one of the most largely attended. No less than 175 members and guests and 61 accompanying ladies were in attendance, as nearly as we can make up the record, which may be somewhat in error, but is substantially accurate. For the conspicuous success of the convention the fortunate choice of a site was largely responsible. Cresson is at the summit of the Allegheny Mountains (or, rather, at the summit of the low pass through which the railway runs) 2,100 ft. above the sea, and is very conveniently accessible both from the east and from the west by the best line of railway in the world. The hotel is large and airy, with ample verandahs, was built exclusively for summer use, and occupies a spot which the city resident is loth to leave rather than in haste to get away from. All this helped to increase and maintain the attendance, and no other kind of place than this should ever be considered for the Am. Soc. C. E. conventions, nor is it likely to be again.

But gratifying as was the attendance, there were some features of it not so wholly satisfactory to those who feel a real interest in the prosperity of the Society. The attendance, as nearly as we can compute it, was distributed as follows, disregarding ladies for the moment only:

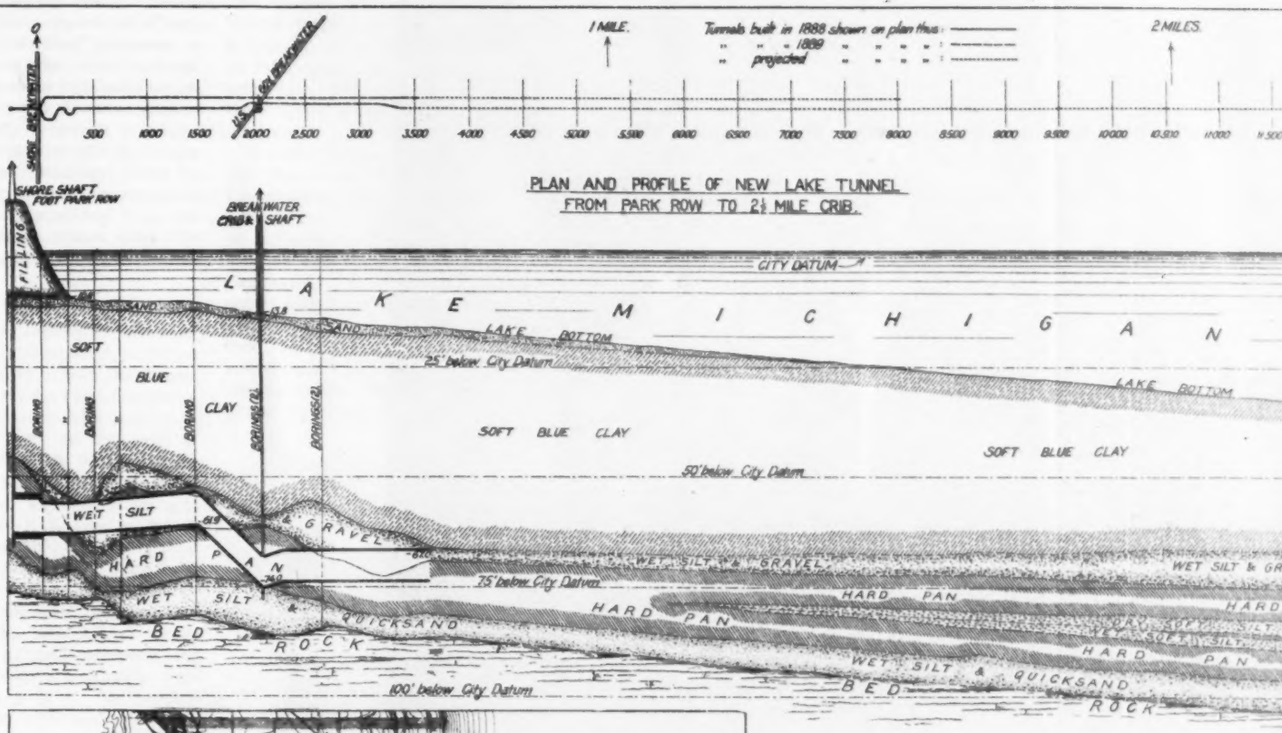
	At convention.	Total members.	Attendance, 1 in
New England States	15	131	8.7
New York and N. Jersey	55	369	6.7
Pennsylvania	53	134	2.5
Del., Md. and So. Atlantic	13	71	5.5
So. Central States	5	75	15.0
Ohio and Indiana	17	70	4.1
Illinois	5	51	10.0
Mich., Wis., Minn., Mo., Ia., Neb., Kans	9	167	18.5
Far West	1	81	81.0
Foreign	2	95	47.5
Total	175	1244	7.1

The attendance naturally tends to vary inversely as the distance, but the region of which Chicago is the center is practically as near to Cresson as New England, and bearing in mind that there is a much larger proportion of qualified members who do not belong to the Society in the West than in the East, that there is greater apathy in regard to the Society in the West is clearly apparent.

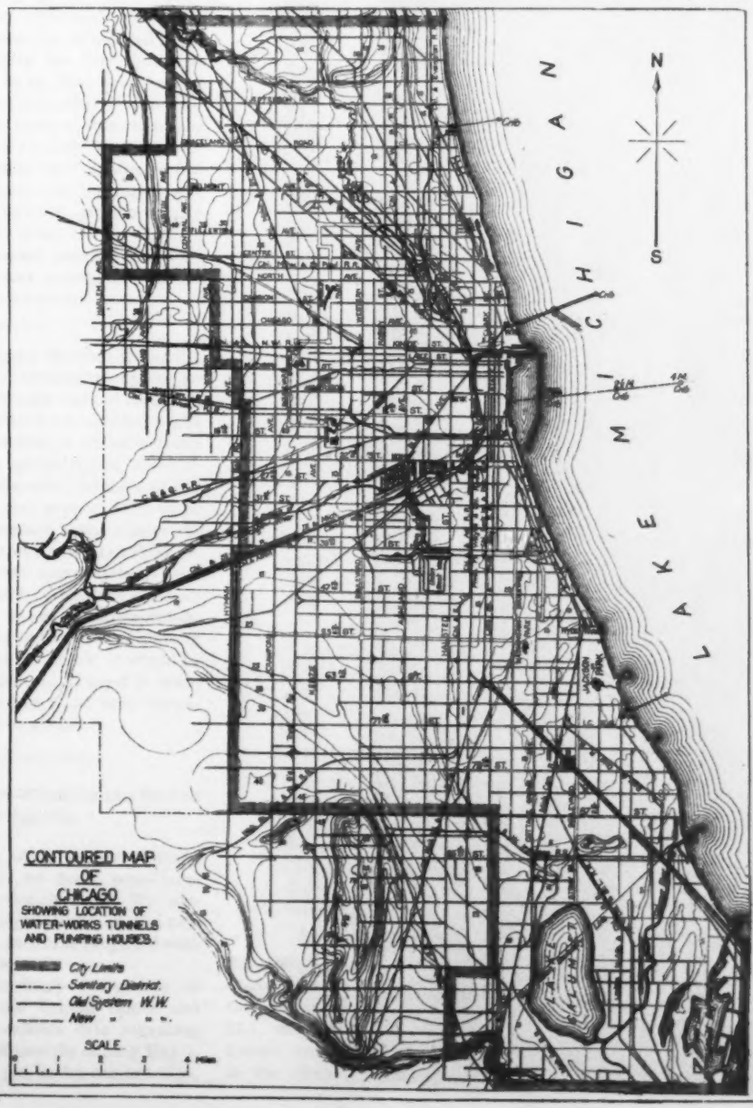
THE papers presented at the convention were unusually excellent, both in number, form and substance; 22 new papers were presented, some of unusual merit. We should take more satisfaction in this fact if it were not so evident that the abundance of papers at the convention had been purchased in part by emasculating the proceedings of prior monthly meetings; hoarding them up, so to speak; but this is no doubt done at the express wish of the authors in many cases, and we are too well pleased with the result to be captious. There were also, for the first time, printed advance copies of at least a dozen papers, ready for distribution at the meeting, although these were not sent out in advance, as they should be, to those members who had indicated an intention to attend the convention, and so a part of the gain to be had from such advance copies was lost. We will not assume that the somewhat earnest protests which ENGINEERING NEWS has felt called upon to make in regard to these matters had anything to do with the great improvements of practice in regard to them; nor do we care whether it had or not. It is sufficient that a new standard has been set, and we trust it will never be fallen below. If it is not, and if as judicious selections as Cresson as a place for a convention continue to be made, it may be confidently expected that the conventions will yearly rise in interest. Socially, the one just past was a great success. The next convention might well be at Chautauqua Lake, Put-In Bay or the Straits of Mackinaw, at each of which points suitable hotels exist.

IT was expected that the most important business before the convention would be the report of the committee on revision of the constitution, with the discussion which would naturally result therefrom, but this expectation was disappointed. The committee, which is now a year old, made no other report than one of "progress" with a request for still more time, submitting without comment a bunch of responses from the various local engineering societies on the question of "affiliation," and even these were so jealously guarded that it was forbidden to give out copies even an hour before the committee responded, with the plain purpose of avoiding so far as possible any chance for discussion. With the same motive, which is no doubt a conscientious one, the committee declines to present even a preliminary report on the many other unsettled questions involved in the revision, in regard to which they have no need for consultations outside of the Society itself; such as the grades, dues and qualifications of membership, the composition, nomination and election of the Board of Direction, etc.,etc. On these questions there is sure to be considerable difference of opinion, and it seems to us it would be much better that the views of the membership as a whole should be informally canvassed by the committee before they undertake to make a final report. Otherwise, even angels sent down from heaven would have little chance of carrying with them over a thousand different men with nearly a thousand different minds as to one detail or another of the society's practice. The better method in such cases would seem to be that pursued by the late rail committee with such conspicuous success in securing general agreement, viz.: to first make a preliminary report giving the pros and cons of all disputed points so far as they see them, then to send out circulars asking specific questions as to the view taken by all those concerned of these pros and cons, then to digest these responses and send out such further inquiries as seem needful and, finally, aided by all the light thus obtained, to submit a final report. The report then comes with sledge-hammer effect, as it rests, not on the views of five or seven members only, but on the general judgment of them all. It is likely to have at least 50 times the weight of one embodying the committee's views alone, for the simple reason that, even if we rate each committeeman as of three times the "weight of the average member, which we fairly should do, they are but one-fiftieth of the total number.

WE are much gratified to learn that the LINDENTHAL North River Bridge bill has passed both Houses of Congress, and will undoubtedly be signed by the President, if it has not been already signed when these lines appear in print. The bill in express terms grants the right to make the necessary condemnations on both banks of the river, and therefore the gentry at Albany and Trenton will not have a chance either to make any effort at a "strike" or to ignorantly impede the progress of a great enterprise by being played upon by interested wire-pullers. For the same reason the backers of the so-called "Greene bill," whoever they are, are not in the position which they apparently hoped to occupy —that of controlling a franchise "on spec," to be either used or sold out, as the wind might chance to blow. We say "apparently," but these appearances are so very strong as to be almost "confirmation strong as proofs of holy writ." They have no plan of their own; they started in proposing a bridge with piers, but finding that Mr. LINDENTHAL'S bridge without piers was the winning card they changed to that, without having any man known to be connected with them who could possibly be trusted



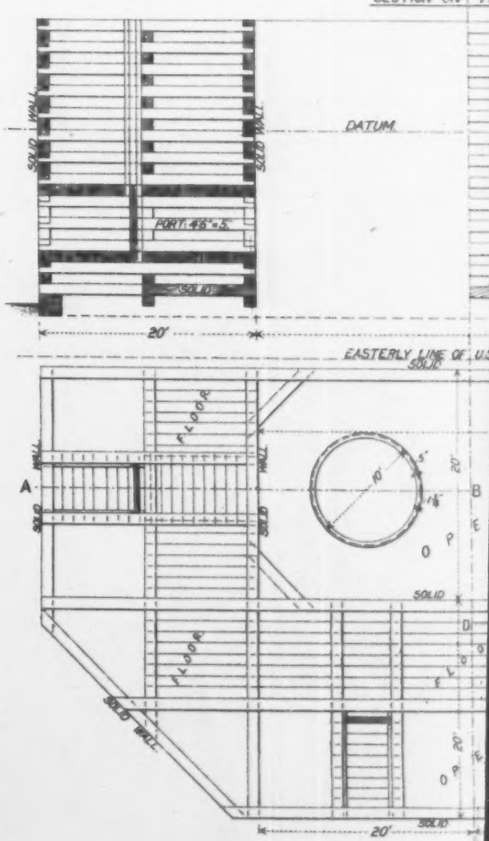
PLAN AND PROFILE OF NEW LAKE TUNNEL
FROM PARK ROW TO 2½ MILE CRIB.



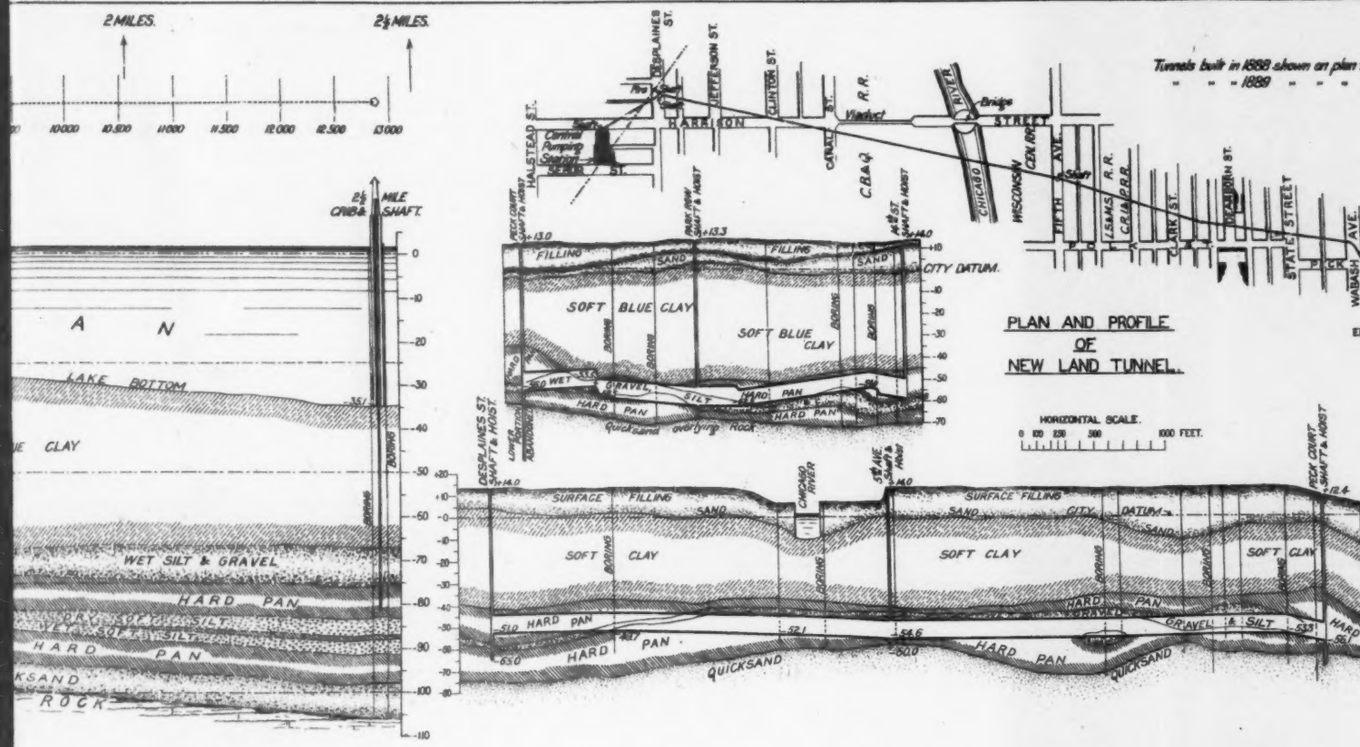
CONTOURED MAP
OF
CHICAGO
SHOWING LOCATION OF WATER-WORKS TUNNELS AND PUMPING HOUSES.

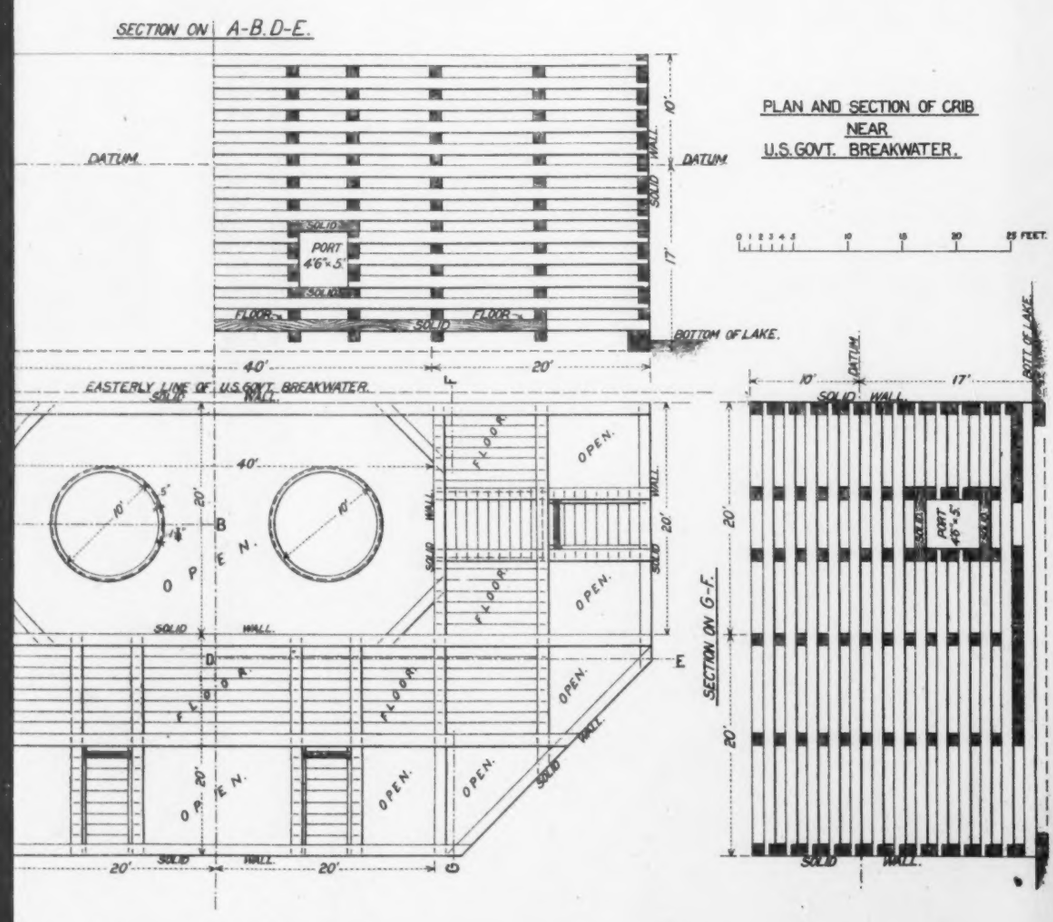
City Limits
Sanitary District
Old System W.W.
New " " "

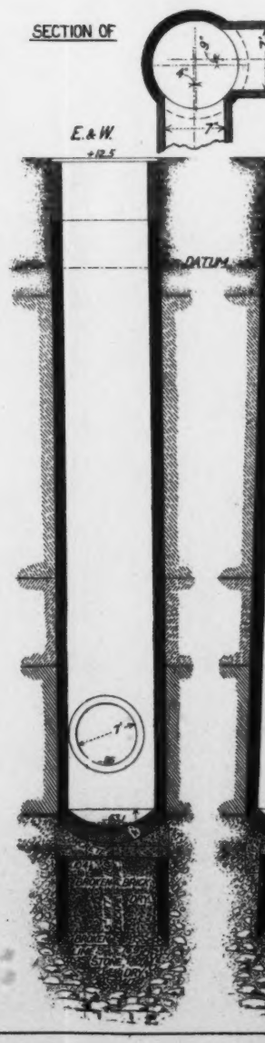
SCALE



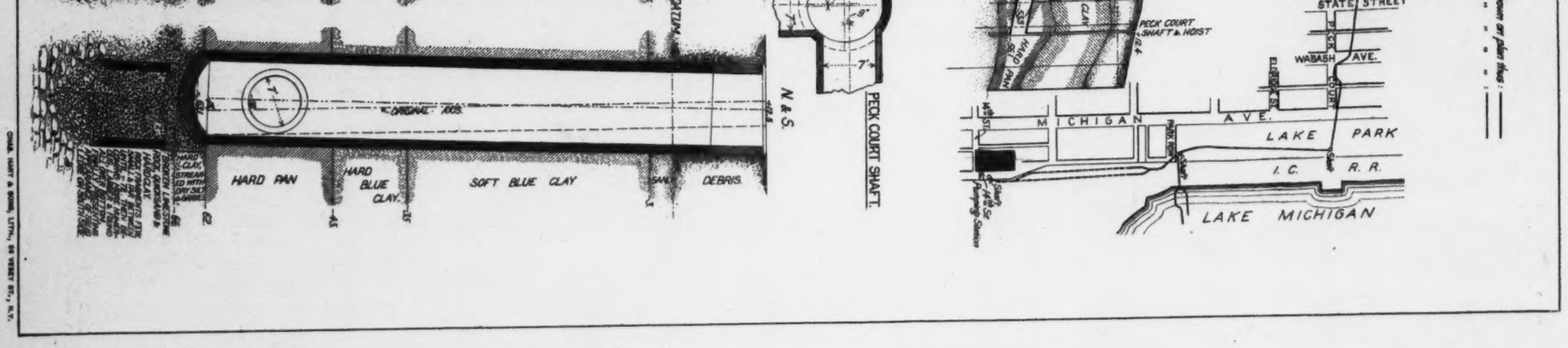
THE NEW WATER-







EW WATER-WORKS TUNNEL FOR THE CITY OF CHICAGO.


HARD PAN
HARD BLUE CLAY
SOFT BLUE CLAY
SAND
DEBRIS
N & S.
PECK COURT SHAFT
PECK COURT SHAFT & HOIST
STATE STREET
WABASH AVE.
MICHIGAN AVE.
LAKE PARK
I. C. R. R.
LAKE MICHIGAN

to prepare such plans. Had they really "meant business" they would not have applied at Albany and Trenton first, but for "striking" purposes, to merely hold the fort, and see what would turn up, a grant from either one of the legislative bodies which ornament those cities was almost as good as from all. Had it been really necessary to obtain their consent to the LINDENTHAL project the Greene bill franchises would now absolutely block its progress, or that of any legitimate enterprise, until they were bought up or another bill had been put through Albany and Trenton, which those who procured the first bill would have known how to defeat.

Mr. LINDENTHAL, or those interested with him, however, have, with admirable sagacity, perceived that it was really unnecessary to have the consent of any other body than Congress for the construction of the work, and, therefore, have quietly allowed the Greene bill to have its own way at Albany and Trenton, where it was naturally introduced first, those being the most easily manipulated bodies. When that bill is brought before Congress in earnest, if it ever is, it will have to pass a very different kind of scrutiny from what it has so far encountered in the State legislatures, and it will have little or no chance of passing unless it can establish the fact that it is a *bona fide* enterprise, backed both by actual plans and by actual financial prospects, and not merely an attempt to control a valuable franchise for what there may be in it. Mr. LINDENTHAL'S plans are original with and were first brought forward by him, and he is entitled in all fairness and justice to have the first chance to carry them out. It seems to us that they are entirely practicable, and there is another reason why we shall rejoice to see him have a fair chance to carry them out; that he is as little likely as any man in America to consent to "skinning" the structure for the sake of economy, but rather will use all his influence to have it architecturally creditable, and built not for a day but for all time, rather than to get the cheapest possible structure which will answer immediate necessities and return the largest immediate revenue.

THE Swinerton Locomotive Driving Wheel Co. are not satisfied with the presentation which we have made in past issues of the facts in regard to their polygonal driving wheel for locomotives, and have instructed us to publish in our advertising columns the matter of a pamphlet just issued by them, which we do with pleasure; and also—of our own motion, and without any request from them—add this note calling attention to the matter, to the end that, if we have in any way done them an injustice, they may have full opportunity to have their side of the case heard. We have given as much space to the matter in our reading columns as we feel justified in doing in the present state of the tests of that device; but we think it would be a matter of great and general interest if some thoroughly reliable tests of just what such wheels are capable of doing could be made.

New and Projected Water-Works in the United States and Canada.

In our review, last week, of the present status of the water-works industry, we made some comments on the new construction of 1889. We present herewith a more detailed study of the new works, together with data on works projected with fair prospects of construction.

Table N includes a summary by groups of States, with totals for the United States and Canada, of the principal available data regarding new works. During the 14 months ending May 1, there were completed, or put under construction, 198 water-works in the United States, and eight in Canada. Of the works in this country six are subsidiary; that is, take their supply from some other plant.

The table shows that of the 198 new works in the United States 77, or 38.9 per cent. were built by municipalities and 121, or 61.1 per cent. by private companies. The record in the MANUAL for 1888, corrected to the close of that year, shows that of 1,762 works in the United States, 742, or 42.1 per cent., were public, and 984, or 55.9 per cent., were private, while the ownership of 36, or 2 per cent., was unknown. The smaller percentage of new public works, as compared with new private, reduces the percentage of public works in the United States at the close of 1889 to 41.7 per cent., while the percentage of private works is increased to 57.1, there being 1.9 per cent. of works of unknown ownership. The numbers corresponding to the above percentages are 818 public, 1,106 private, and 36 works of unknown ownership. These figures show a very slight gain in the proportionate number of private works. It is interesting to note in this connection that of the projected works commented on below 108 are reported as public, and 108, the same number, as private enterprises. The remaining 42 projects were not sufficiently advanced to give the proposed ownership. Of the 8 new Canadian works 5 were built by municipalities, 2 by private companies, while the ownership of one is unknown.

The figures in the last three columns of the table are considerably too small, as in many cases the reports were made before construction was finished, there being not even sufficient data to enable one to make reliable estimates.

A comparison of the data for new works with that for works built prior to 1889 is given below. The lines entitled "additions" give data for works included in the supplement to the 1888 MANUAL, and for a few works not reported in time for inclusion in that issue, and is added to the 1888 record in order to give the actual figures for 1888. It should be borne in mind that the sums of the 1888 totals and the figures for new works, in the last three columns would not be the total cost, miles of mains and hydrants for 1889, as they would not include either extensions made to old works or the cost of the same.

United States Water-Works.

	1880. Population.	No. of works.		Cost.	Miles of mains.	No. of hydts.
1888 record.	14,857,612	(68)	1,508	$432,225,546	24,257	168,511
Additions..	195,731	(3)	93	4,009,361	397	2,218
Total, 1888.	15,053,343	(71)	1,601	436,234,907	24,654	170,729
New.....	497,006	(6)	192	7,997,165	899	5,815

Canadian Water-Works.

1888 record.	737,043	(3)	68	21,313,809	1,371	9,314
Additions..	14,533		8	376,000	40	126
Total, 1888.	751,576	(3)	76	21,689,809	1,411	9,440
New.....	26,595		8	417,000	45	341

In the MANUAL for 1888 there were included as projected, with fair prospects of construction, 152 water-works in the United States and 7 in Canada. In the 1889-90 MANUAL there are described 258 such projects in the United States and 7 in Canada, a gain of 106 in the United States.

Table P shows the distribution by States and and groups of States of the projected works for both years, and also the estimated population which these works are designed to supply. It will be seen that Delaware, Montana and Nevada are the only States and Arizona and New Mexico the only Territories not reporting new projects, and that six States report but one project each. Pennsylvania and Texas each report 13, and Georgia, Nebraska and South Dakota each report 12 projects. The North Central group has 54 and the Pacific but 25 projects, while the six other groups have each about the same number, the range being from 27 in New England to 32 in both the South Central and North Central groups.

The number of works built in the period covered by this summary exceeded the projected works included in the last MANUAL by 29. Making due allowance for our increased facilities for collecting information regarding new projects and new works, and thus, in part, for the increased number of projects in the 1889-90 MANUAL, it seems safe to say that water-works construction in 1890 will be nearly or quite as active as in 1889, and that there will be at least 175 new works to add to our list by

TABLE N.

NEW WATER-WORKS IN THE UNITED STATES AND CANADA—SUMMARY BY GROUPS OF STATES OF THE PRINCIPAL DATA.

Group.	Popn. on w.-wks., 1880 census.	Number and ownership. Pub.		Priv.		Total.		Cost.	Miles of mains.	No. of hydrants.
N. E.....	48,383			8		11	19	$1,027,625	125.4	561
Mid.....	189,416	(1)	8	(2)	30	(3)	38	1,785,803	199.55	1,714
So. Atl.....	27,202		5	(1)	10	(1)	15	344,500	40.75	235
So. C.....	43,869		..	(1)	12	(1)	12	479,000	76.75	574
No. C.....	86,246		26		12		38	2,003,837	208.50	1,332
N. W.....	53,334		20	(1)	18	(1)	38	1,144,810	130.93	794
S. W.....	17,811		4		6		10	399,000	62.3	555
Pac.....	30,745		5		17		22	812,500	59.9	230
Total U. S..	497,006	(1)	76	(5)	116	(6)	192	$7,997,165	899.17	5,815
Canada.....	26,595		5		2		8*	$417,000	45.25	341

* Including one of unknown ownership.

TABLE P.

PROJECTED WATER-WORKS IN THE UNITED STATES AND CANADA.

	1889-90 MANUAL. Est. pop.	No.	1888 MANUAL. No.
Maine.....	5,900	4	12
New Hampshire...	20,900	9	3
Vermont.....	3,000	3	..
Massachusetts....	28,500	9	5
Rhode Island.....	18,500	1	4
Connecticut.....	4,000	1	3
N. E. Group.....	80,800	27	27
New York.....	25,900	10	11
New Jersey.....	25,150	6	2
Pennsylvania.....	30,000	13	7
Delaware.....	.....	..	..
Maryland.....	3,800	1	3
Middle Group..	84,910	30	23
Virginia.....	2,000	1	8
West Virginia....	2,000	1	1
North Carolina...	6,800	3	4
South Carolina....	9,100	6	3
Georgia.....	34,200	12	8
Florida.....	32,800	6	3
So. Atl. Group...	86,900	29	27
Alabama.....	5,300	4	6
Mississippi.....	7,500	3	3
Louisiana.....	4,500	2	..
Tennessee.....	31,300	14	5
Kentucky.....	34,000	9	5
So. C. Group.....	82,600	19	32
Ohio.....	34,500	10	4
Indiana.....	25,600	6	1
Michigan.....	18,200	5	3
Illinois.....	24,000	8	9
Wisconsin.....	8,800	3	4
No. C. Group....	111,100	32	21
Iowa.....	17,950	11	8
Minnesota.....	21,500	11	1
Kansas.....	9,100	5	7
Nebraska.....	10,500	12	3
South Dakota.....	7,300	12	3
North Dakota.....	.....	1	..
Wyoming.....	2,300	2	2
Montana.....	.....	..	..
No. W. Group...	68,650	54	24
Missouri.....	10,000	4	2
Arkansas.....	14,400	6	2
Texas.....	26,100	13	8
Colorado.....	5,200	6	5
New Mexico.....	.....	..	..
S. W. Group..	55,700	29	19
Washington.....	17,300	11	4
Oregon.....	6,100	4	2
California.....	10,900	5	3
Arizona.....	.....	..	..
Nevada.....	.....	..	..
Utah.....	7,000	3	..
Idaho.....	6,000	2	..
Pacific Group....	47,300	25	9
Total U. S.....	617,960	258	169
New Brunswick...	1,800	1	..
Nova Scotia.....	4,400	1	1
P. E. Island.....	.....	..	..
Newfoundland.....	.....	..	..
Quebec.....	750	1	1
Ontario.....	5,500	1	2
Manitoba.....	500	1	..
Northw'st Ter....	4,000	1	..
British Columbia..	12,000	1	..
Total Canada....	28,950	7	7

the first of next May. But while the yearly number of new works may remain about the same for a few years the increase in population is not sufficient to keep up the average population of the towns supplied. This is illustrated by the fact that the average population on the new works reporting the same in the United States, is about 3,600, the average being based on the population of the 1880 census, which is considerably below the actual population. The average *estimated* population on projected works reporting the same is but 2,500. Thus it will be seen that there is a difference in the two averages of 1,100, which would certainly be increased to 1,500 and possibly to 2,000 if the estimated populations were taken in each case.

The Laws of Air Resistance.

We publish in another column an article by Prof. HAZEN, of the U. S. Signal Service, in which he discusses somewhat adversely the conclusions reached by Mr. O. T. CROSBY in his paper on air resistance lately published in these columns, as also our own suggestions, made last week, for further and more decisive air resistance tests. The method we proposed was to drop a flat car down a known grade, determining the velocities acquired at successive points electrically; thence determining the resistances of the flat car only, and then erecting frames of various kinds and forms on the flat car, and repeating the same tests and determinations; the added resistance, plainly, being due to the added air resistance alone, accept as the rolling resistance of the car might vary. In regard to this method of test Prof. HAZEN says:

As to the method of determining the effective resistance against square plates by running cars down a grade without the plates and afterwards with the plates, as suggested by some one in the last issue of the NEWS, it must be said that this would be an exceedingly crude and unsatisfactory method of conducting such an experiment. It is a very simple matter to measure the total pressure on a plate in straight line motion. . . This whole problem can be completely and satisfactorily settled . . . on a straightaway track for three miles with a locomotive and two or three weighted cars in front. Several efforts to obtain such conditions with railroads have failed, and only when some enterprising company sees the importance of this problem can we hope to gain a complete and satisfactory solution. There is no doubt that some one can be found to attack the problem if the means are provided.

We are compelled to differ from Prof. HAZEN, both in regard to the method which he approves herein and the method he condemns, unless he can state that he bases his condemnation and approval on an actual trial of both of these methods. The present writer does base his views on actual trial of both of them, and he regards an attempt to obtain intelligible, consistent or valuable results by such use of a locomotive as proposed as almost hopeless, for the reason that the locomotive has a jerky, intermittent motion when lightly loaded, while the cars and locomotives behind would also affect the air resistance, more or less, by an interminable amount. On the other hand, by dropping a car down a known grade the velocities and resistances can be determined with extreme delicacy, and the disturbing causes would be reduced to a minimum.

To show the results of this method, and that SMEATON'S formula gives results in general very largely in excess when applied to areas the size of an ordinary box car, we make the following extract from a paper describing "Experiments on the Resistance of Rolling Stock" [Trans. Am. Soc. C. E., Feb., 1879]. It will be seen to amount to absolute proof that in such cases the Smeaton formula gives much too high results.

Thus Smeaton's table, quoted in most of our text-books, gives 5 lbs. per ton as the air-resistance at 10 miles per hour, and D. K. Clark's recently published "Manual for Mechanical Engineers" rejects even this as too small, and gives data* tending to show that the resistance is 1 lb. per sq. ft. at 10 miles per hour, *and increases rapidly with the area*. The simple calculation below, however, proves beyond question that these current formulæ, when applied to areas of the size of a box-car and to ordinary train-speeds, are in excess by from 250 to 500%; for it appears that if Smeaton's formula were correct, the maximum velocity attained by an empty box-car descending a grade of 37 ft. per mile would be only 13.24 miles per hour without allowing anything whatever for oscillatory resistance; while the velocity actually observed for such a car was 17.5 miles per hour, *which was still increasing*, after descending 6,200 ft. If D K. Clark's data were correct, the maximum velocity attained would be only 9.36 miles per hour. If the air resistance be taken at 14 lbs. per ton, as above, the maximum velocity attainable, if there were no oscillatory resistance whatever, would be 22.68 miles per hour.

For the computations we have the following data: Weight of box-car, 9 tons. Rolling and axle friction, 6 lbs. per ton. Grade 0.7 per 100 = 14 lbs. per ton accelerating force.

Then, if the air resistance be ½ lb. per sq. ft., at 10 miles per hour, we have 82.2 sq. ft. × .5=41.1 lbs., = 0.411 lbs. at 1 mile per hour; and we have, letting V = the maximum velocity attained in descending the given grade,

$$0.411\ V^2 + (6 \times 9) = (14 \times 9)$$

as the equation of maximum velocity attainable,

whence $$V^2 = \frac{72.}{0.411}$$

and $$V = 13.24 \text{ miles per hour.}$$

If the air resistance be 1 lb. per sq. ft., as by D. K. Clark's data, we have

$$0.822\ V^2 + 54 = 126$$

whence $$V^2 = \frac{72g.}{0.882}$$

and $$V = 9.36 \text{ miles per hour.}$$

If the air resistance be only .14 lbs. per sq. ft., we have

$$V^2 = \frac{.72}{.14}$$

$$V = 22.68 \text{ miles per hour.}$$

Mr. CROSBY, himself, however, has suggested to us a method for further air resistance tests which seems to us better than any other, viz., by dropping bodies of various forms and weights from some high tower, like the Washington or Bunker Hill Monument, and determining the time of descent electrically; a light frame work being built out from the top, and vertical wire guides stretched to guide the descending body. In this way all disturbing elements would be eliminated, and the atmospheric resistance determined with great nicety. If only the total time of descent be taken the method is somewhat indeterminate, since it would be impossible to determine how the time of descent had been distributed, except by assuming the very thing to be proved, whether air resistance varies as v, v^2 or v^n; but by adding electrical circuit breakers every 50 ft. or so of the descent, this difficulty would be overcome completely, and the velocity and resistance at any point could be determined with great precision, and for all varieties of areas, forms and weights. In comparison with this method any form of tests with locomotives would be clumsy indeed. But one serious difficulty need be encountered, the fact that the atmosphere is never, except by accident, absolutely still, or of precisely the same weight; but the barometer would afford the means of eliminating the last irregularity (which would amount to little anyway), and to eliminate the first (or, for that matter, the second also) a certain constant area and weight might be dropped before and after each test so as to afford a constant basis of comparison or correction.

Prof. HAZEN is, we think, mistaken in his belief that it is the facilities, not the man, which is lacking for tests of this kind. Let any man come forward willing and able to make such tests and it would be easy to find railway companies willing to furnish the facilities if convinced that useful results were likely to follow. The doubt is as to the trustworthiness of the results, not as to their utility, and in this doubt we think them right. Government officers at Washington, however, have a grand chance to determine the laws of air resistance by the aid of the Washington monument, and we cannot but hope that some of them may yet attempt it, with the facilities already at their command, rather than to seek much poorer ones from railways.

As for the objections to the whirling method of determining air resistance, we agree with Prof. HAZEN entirely. We cannot but feel that there, if anywhere, is the defect in Mr. CROSBY'S apparatus which has misled him, his whirling arms having been only 5½ ft. long. How the centrifugal force created in the air could make so great a difference as to vitiate Mr. CROSBY'S conclusions, however, we are unable to see, especially in view of the simple tests which he describes, showing that the surrounding air was not seriously affected centrifugally, but practically still. The theoretical formulas on this subject we attach little weight to. It is pre-eminently one for experiment, not theory, except as expressly based on experiment. Among all the experiments so far made, Mr. CROSBY'S tests seem to us, as at present advised, entitled to quite as much weight as any others ever made. He is entitled to the benefit of a doubt. His seemingly anomalous conclusions should be disproved experimentally before they are rejected.

* On p. 897. Data "reduced from Jas. C. Fairweather's Exp'ts. Proc. Royal Soc. Edinb. 1872-3."

A Question of Title.

It may be remembered by some of our readers, although it probably was not noticed by most of them, that in February, 1888, we made a slight change in the form of the title of this journal, from

ENGINEERING NEWS
and
AMERICAN CONTRACT JOURNAL.

to the following form, viz.:

ENGINEERING NEWS
and
AMERICAN RAILWAY JOURNAL,

the change consisting merely in the substitution of the word "Railway" for the word "Contract" in the sub-title, this sub-title then and now being used only on the cover page and at the head of the editorial page, and the form and type of the title remaining otherwise identical.

This change was deemed desirable in order that the title might approximate more closely to the real character of the journal, while making as slight and inconspicuous a change of its form as possible. It was objected to, however, by Mr. M. N. FORNEY, editor and proprietor of the *Railroad and Engineering Journal*, as an infringement on the title of that journal, on the ground that it was a successor to one known as the *American Railroad Journal* as well as to *Van Nostrand's Engineering Magazine;* these two journals having been purchased by Mr. FORNEY, suspended as separate publications, and consolidated into the *Railroad and Engineering Journal* on or prior to Jan. 1, 1887.

The *American Railroad Journal* (to state only undisputed facts) was founded in 1832, and was at the time of its suspension "the oldest railroad paper in the world." For about a quarter of a century after it was founded, or till about 1857, it was also the best and almost the only railroad journal in the world; such men as ZERAH COLBURN, HENRY V. POOR and others being its editors, and its volumes during these years are mines of technical information about the earlier railways. But along in the 50's, or nearly forty years ago, it fell upon evil times, and became first an almost exclusively financial weekly, and finally, after various vicissitudes, ended up as a rather trashy monthly, owned and conducted by a firm of varnish makers, and, to all appearance, published merely as a medium for advertising its wares, since both the subscription rate and circulation were purely nominal. In this condition it had been for many years when it was purchased by Mr. FORNEY simultaneously with *Van Nostrand's Engineering Magazine*, as stated, both being used as the foundation for the excellent engineering journal which he has since conducted, and which is of a quite different

character, as well as name, from either of the two journals on which it was nominally founded.

It is needless to say to our readers that the resemblance to title of an extinct journal, resulting from the slight change of title shown above, was a purely accidental one, in no way contemplated or desired by the ENGINEERING NEWS Publishing Co. and of no possible benefit to it. Mr. FORNEY, however, considered it an infringement of his rights and brought suit for an injunction. The following is the decision of the court on this application; fully sustaining the position of this journal both as to the law and the equities of the case:

MATTHIAS N. FORNEY against THE ENGINEERING NEWS PUBLISHING COMPANY. } *Supreme Court. Special Term, Nov., 1889.*

BEACH, J.—In January, 1887, plaintiff issued the first number of a monthly periodical, named *The Railroad and Engineering Journal*. In 1886 he had purchased, for five hundred dollars each, two monthly publications, called respectively *The American Railroad Journal* and *Van Nostrand's Engineering Magazine*; the issue of January, 1887, was the result of the consolidation. There is slight proof tending to show that *The American Railroad Journal* was, to a limited extent, known, and sometimes spoken of, without the prefix of "American."

The defendant publishes a weekly periodical now named *Engineering News and American Railway Journal*. It is the outcome of a prior publication first called *The Engineer and Surveyor*, then *The Engineer, Architect and Surveyor*, then *The Engineering News*, then with an addition of *American Contract Journal*, and lastly *Engineering News and American Railway Journal*, since February, 1888. The defendant's paper seems usually called the ENGINEERING NEWS, and the letter heads, stamped envelopes and subscription orders bear the abbreviated title only. I think it a fair deduction from the evidence that the plaintiff's paper is sometimes called *Forney's Paper* and *Forney's Railroad Journal*.

Upon these facts the plaintiff prays the Court to enjoin the defendant from using the words "Railway Journal" in its title. To grant this relief would, in my opinion, extend the exercise of equitable power beyond the limits ever before reached by adjudication. Above and beyond the technical rules regulating the application of equitable relief lies the broad principle, necessitating a living equity in a plaintiff's case rather than a skeleton only, held together by the thin wire of abstruse reasoning. In the case at bar plaintiff's publication had but a limited circulation, and there is an utter absence of evidence even tending to show actual confusion in any instance from the claimed similarity in name; while the titles as printed, instead of indicating possibility of error from defendant's use of the words "Railway Journal," rather show probable confusion and mistakes from plaintiff's use of the term "Engineering." Considering the titles in full, I cannot see any real similitude. To select therefrom two words, which are not the popular appellation of either or both, and enjoin their use by defendant, would unnecessarily extend the boundary line limiting the discreet exercise of equitable power. I should question the propriety of its exercise upon the sole fact that one publication was called the *Railroad Journal* and another *The American Railway Journal*. Extrinsic facts, such as resulting confusion, intent to imitate, probable imposition upon subscribers or purchasers, would be needful where resemblance is so slight.

The learned counsel for plaintiff relies mainly upon the case of *American Grocer Publishing Assn. v. The Grocer Publishing Co.*, 25th *Hun*. 398. The proof showed there that plaintiff's paper was known and commonly called *The Grocer*. One PRICE was its editor until 1875, when he ceased to act, and began the publication of a new paper called *The Grocer*, issued Dec. 11, 1875, published on same side of same street and block as the plaintiff's, and when plaintiff removed to another locality, the defendant followed. In addition there was some evidence of business confusion, united with the marked similarity in name, in fact, and of exactness in common designation. The cases cited by the learned justice also show an imitation, lacking in this case. In *Howard v. Henriques*, 3d *Sand*. 725, the titles were "Irving House" and "Irving Hotel." In *Clement v. Maddick*, 5th *Jun. N. S.* 502, the use of words "Bell's Life" in newspaper titles was enjoined because plaintiff's journal was familiarly known by that name. In *Ingram v. Stiff*, 5th *Jn. N. S.* 947, the names are alike. The French adjudications are upon like facts, the *Moniteur Universal* and the *Moniteur Official*, because it incontestably appeared that the former was always known as the *Moniteur*. Others, the *Press* and the *Free Press*, the *Petit Journal* and the *Petit Journal de la Seine*.

The principle is that there must be an adaptation of plaintiff's title either exact, or to an extent sufficient to show an appropriation of words producing similitude in the titles themselves, or from well established popular designation.

Within this principle the plaintiff has failed to bring his case by proofs, and the relief sought by his bill of complaint must be denied.

Decree for defendant with costs.

This decision was appealed from by the plaintiff. The following is the decision on appeal:

MATTHIAS N. FORNEY, Aplt., agst. ENGINEERING NEWS PUBLISHING CO., Rspt. } *Supreme Court, First Department, May, 1890.* CHAS. H. VAN BRUNT, P. J.; JOHN R. BRADY, CHAS. DANIELS, J. J.

Appeal from judgment dismissing complaint.

VAN BRUNT, P J.: It does not seem necessary to discuss at large the question presented upon this appeal. The facts are distinctly stated in the opinion of the court below, and the grounds upon which the relief should be refused to the plaintiff are there correctly set forth.

The cases of Stokes vs. Allen decided at the May term of this court, and Richardson & Boyton Co. vs. Richardson & Morgan Co. (27 N. Y. State Rep. 308), also serve to illustrate the correctness of the conclusions arrived at.

The judgment should be affirmed with costs.

Concur, J. R. BRADY, CHAS. DANIELS.

CORRESPONDENCE.

The Laws of Air Resistance.

WASHINGTON, D. C., June 23, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: I have read with great interest the articles upon "Air Resistance," by Mr. CROSBY, in recent issues of ENGINEERING NEWS. I will send you a paper published in '87, and also a short article for publication if you desire. Mr. CROSBY'S results are certainly very extraordinary, and well-nigh incomprehensible. There is nothing so well established as the law that resistance to plates exposed free and normal to the impinging current varies according to the *square of the velocity*.

H. A. HAZEN, Asst. Prof. S. O.

[Prof. HAZEN'S article is published in another column, as also some editorial comments thereon.—ED ENG. NEWS.]

The Hungarian Zone System of Passenger Fares.

COLUMBUS, O., June 27, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: An interesting experiment is now being made in Hungary in the matter of cheap transportation of passengers and uniform tickets. There has been issued a government report of the first eight months' trial of the system of which, I understand, there now appears an English translation.

With Buda-Pesth, the capital, as the center of thirteen concentric circles, the whole territory is divided into zones, fourteen in number, varying in width from 15 to 25 kilos. (equal approximately to 9.3 to 15.5 miles), but for the most part 15 kilos. in width. The first circle is 25 kilos. from the center, and all of the territory outside of the thirteenth circle comprises the fourteenth zone.

For a journey originating and ending in a given zone a ticket known as a one-zone ticket is issued. For a journey originating in one zone and extending into an adjoining zone a two-zone ticket is issued. For a journey originating in a given zone and extending across an adjacent zone into the next a three-zone ticket is issued, and so on up to fourteen-zone tickets. These tickets are sold anywhere, like postage stamps, are good till used, and are received for transportation on any railway in any part of Hungary. The price is uniform, a fourteen zone ticket costing fourteen times as much as a single zone ticket. The price is made very low, and the tickets are divided into first, second and third-class tickets, as is the custom in Europe. With a third-class ticket one can journey about 700 kilos. (equal to about 435 miles) for about $1.68. A second-class cost about twice, and a first-class about three times this amount.

In addition to the tickets above mentioned, tickets for shorter journeys are sold, of three kinds, according to the distance, as from one station to the next, to the second and to the third station at prices ranging from about 6 to 10 cents per ticket.

One would suppose that in order to make effective a system like this it would be necessary for the government to own all the railways, but I understand that this is not the case, as the government only owns a portion of them.

It is stated that the effect of this experiment in eight months of trial has been to quadruple the travel, and that notwithstanding the low rates, gross receipts have also been increased over the old system in the same period, and this, too, with a population that is quite sluggish as compared with the American people. Most of the increase has been in journeys of the shorter class.

A desire to know more about this novel experiment; to see an accurate map of Hungary showing the railway and the zones; to receive information as to the system by which balances for ticket sales are made; together with a wish for some guesses by competent experts as to the probable economic and social results of this experiment, is the excuse for troubling you with this communication.

JULIAN GRIGGS.

[Our correspondent's information is in the main entirely correct. The experiment is attracting the attention of the world, and we have from time to time published a good deal about it. We shall, in a following issue, publish still more about it, giving the completest information yet made public. It has been more than successful; it is a brilliant and complete success. It has been extended from Hungary over the whole Austrian Empire, and instead of having only one center, each little town and even village is a center, thus doing away with the unfairness which would result to towns just on the edge of a zone. The tickets are good everywhere, and are practically 15, 30, 50-mile tickets, etc., good for that distance on any railway. The discount is chiefly on third class tickets, and, as a consequence, that is the class of traffic which has been chiefly stimulated.—ED. ENG. NEWS.]

Grades at Street Intersections.

TOPEKA, Kan., June 25, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of June of 21 "W" inquires as to the method of computing grades of street intersections. In the absence of anything better I have used the following, the condition being: Given the grade of the intersection of two streets, each having from the given intersection an ascending grade, to determine the profile of the intersection that will give between the block corners, on both sides of the street, the same tranverse declivity of side walk and of roadway and provide for the passage of water by a gutter on the higher side of the street. For the grade of the initial block-corner of any intersection take the highest grade of the street on which the lots front at its intersection with the side of the street it crosses. If both streets have lots fronting on them, take for the grade of the initial corner a mean between the grades of the two streets at their intersection with the sides of the streets they cross. From this initial corner descend to the opposite corners at the rate of, say, a maximum of 1.23 per cent., and from each of these corners also descend at same rate to the fourth corner.

This difference of elevation with the summit of street at one-third the width of roadway from the higher side and a difference of 5 ins. in depth of curbstone will satisfy the above requirements. Should circumstances require a greater difference of elevation of the opposite corners, the summit of street can be placed at one-fourth the width of roadway from the higher side and the difference between the depths of curbs increased, with summit at one-fourth the width of roadbed, and a difference in depth of curb of 6 in., a difference in elevation of opposite corners of 1.06 per cent. can be obtained.

WM. TWEEDALE, C. E.

The Swelling of Cement.

NEW HAVEN, Conn., Jan. 24, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: In your issue of the 14th inst. you notice some recent investigations made by a German railway as to the cause of swelling of cements. While the conclusions arrived at were to the effect that the swelling was due to the presence of magnesia, I am pleased at the exceptions taken by you to this erroneous conclusion. The important bearing of this question upon a large American industry is my excuse for trespassing on your valuable space.

There are produced in this country annually over 5,000,000 bbls., of what may be termed magnesian cements. It is this class of cements that was used in building for New York City, both the old and the new Croton aqueducts, the High Bridge over the Harlem, and on all the bridges over the Hudson and Niagara Rivers.

Does anybody notice any failures in these structures on account of the "swelling of the cements"? Examine the High Bridge: Is there any finer masonry work to be found anywhere? Yet the cement used in this bridge contained as large a percentage of magnesia as did that reported upon by the German railway.

Portland cements contain little or no magnesia, yet they will expand when used fresh; as is shown when placed in glass bottles in the form of grout, cements containing an excess of either lime or magnesia will expand unless such excess has been thoroughly hydrated before using.

If silica and lime, or silica, lime and magnesia are present in true combining proportions, there will be no expansion if these ingredients are intimately commingled.

The German railway company find a cement containing 2½ magnesia to swell, and, in their judgment, the swelling is due to its presence; yet I know of a cement containing 43% silica and 57% of magnesia that has never swelled in the slightest degree. A cement may contain the precise combining proportions of clay and lime and still expand, because of an imperfect mixture of these ingredients. Artificial cements are peculiarly liable to this danger.

In ninety-nine cases out of every hundred the swelling of a cement is caused by the presence of free lime or free magnesia, one or both, either in excess or imperfectly commingled; and it may be entirely cured by proper seasoning or hydrating. They then become preferable to

cements containing an excess of clay, as the latter are liable to shrink.

In conclusion, allow me to thank you for not permitting a notice of such failures to pass without pertinent and well-timed editorial comment. U. CUMMINGS.

The Mekarski Compressed Air System.

LONDON, June 16, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Seeing that you are giving a full account of the so-called "MEKARSKI" system of using compressed air for propelling purposes, and that you express a favorable opinion of giving a dose of heat to the compressed air before entering the cylinder, I beg to call your attention to the fact that this is not the invention of MEKARSKI at all, but was patented by an Englishman, one JAMES GLAZEBROOK, who in his Patent No. 2,164 of 1797 described the results obtained by passing the air through a vessel of heated water, and expanding it thereby.

In 1801, in his Patent 2,504 of that year, he further describes his improvements on his first patent, and proposes using it to propel pistons or other mechanical apparatus, as you will see by referring to his two specifications.

Feeling sure that you desire to record nothing but facts in your valuable and interesting journal, I send you this information.

Some years ago a gang of company promoters in London got up a company to purchase this "invention," but finding from these patents that the whole matter was public property and that consequently they had nothing to sell, and that the public had nothing to buy, it "burst up," to the great disappointment of the promoters, who had stood in for a good "pull" out of the pockets of the public. CHAS. F. T. YOUNG, C. E.

[Certainly it was not with any intention that it was even implied in anything we published that giving a "dose of heat" to compressed air was in any sense original with MEKARSKI, or any other inventor of the present generation. It has been used in a dozen different plans for working compressed air within the past 20 years, and long since we should have said had become an axiom of engineering. GLAZEBROOK may well be the first who ever discovered the useful effect of such heating; we know of no evidence to the contrary, at any rate. The great benefit of the process is that it converts the heat so applied into power at nearly its theoretical efficiency, and that it will do so is so evident from our modern knowledge of thermodynamics that no special credit could attach to any contemporaneous suggestions of the kind, even were it novel.—ED. ENG. NEWS.]

Laying Out Race Tracks.

MEDINA, O., June 28, 1890.

TO THE EDITOR OF ENGINEERING NEWS:

SIR: Observing in your notes and queries an inquiry relative to laying out race tracks, I beg to send you the following in reply to the inquiry:

Turf, Field and Farm gives the following:

Half-Mile Track - Lay off two parallel sides, 600 ft. long and 452.36 ft. apart, connected at each end by a perfect semi-circle of 226.18 ft. radius. The above gives the extreme inside line curve, 25° 32'. Make the track 25 ft. wide on straight portion, and 30 ft. wide at center of curves.

Mile Track—Lay off two parallel straight sides, 1,320 ft. long and 832.33 ft. apart, connected at each end by a perfect semi-circle of 417.17 ft. radius. Curve, 13° 46'. General width, 50 ft. and 60 ft. on homestretch. The above gives the extreme inside line. The true measurement of the mile or half-mile is 3 ft. from the inside fence. The proper slope of track on curves is 1 in 12 to 1 in 15. On the straight track raise the outside 1 ft. to secure proper drainage. The judges' stand should be placed one-fourth the length of one of the straight sides from the first turn. Clay well rolled and drained will make a good track. Loam will be better for a training track, not being so hard on horses' feet. A mixture of gravel will make it faster.

To set off the one mile and half-mile lines for race tracks, easing off the approaches to the curves, formulæ may be deduced by the aid of SEARLES' "Railroad Spiral."

EDWARD BARRINGTON.

Notes and Queries.

Mr. C. Delafield, No. 2 Wall St., will give H. C. the information he desires as to laying submerged pipe, if he will communicate with him.

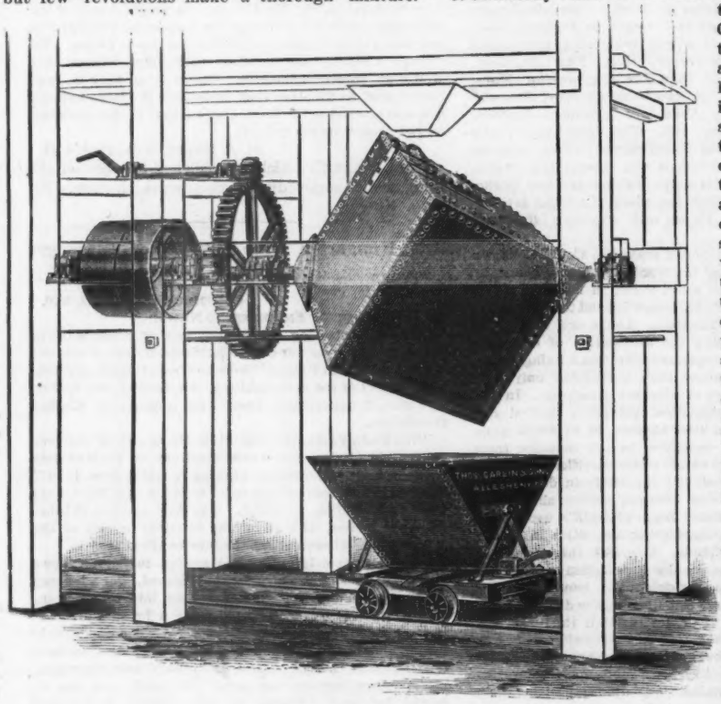
Our correspondent of June 21 will find an article on laying out race tracks in the last report of the Iowa Society of Civil Engineers and Surveyors, price 35 cts. Address Mr. SETH DEANE, Secretary, Glenwood, Ia.

J. W. L. writes: Would you please inform me, if possible, what is the coefficient of elasticity of first-class Rosendale cement. If you have no figures on the subject, you would oblige me by placing the question in your columns. What I wish to arrive at is the amount of elongation due to fixed loads per sq. in. of good Rosendale cement under a set in the air of say one month.

Mr. R. L. HALL, C. E., Oconto, Wis., writes as to race tracks: *Wilkes' Spirit of the Times*, June 26, 1880, has diagrams and instructions for half-mile and for mile tracks. The great call for the paper induced it to keep on hand copies of that number (20, Vol. 99), and the pages were electrotyped. Within six years I have laid out two tracks upon the *Times* plan, and these tracks are considered among the best. Experience suggested methods in laying out and construction which I found valuable; these I will lay before your correspondent should he want them.

Improved Concrete Mixer.

The accompanying illustration shows a concrete mixer, manufactured by Thomas Carlin's Sons, of Allegheny City, Pa., which is claimed to be unusually convenient and effective for mixing concrete and other like material. The mixer proper is the familiar square box, pivoted diagonally in such manner that the material within it is constantly in motion while the machine is in operation, so that but few revolutions make a thorough mixture.



IMPROVED CONCRETE MIXER.

This box is more nearly a cube than are most of its type. The material to be mixed is put through a hinged door, which is located so that the material will discharge freely and cleanly when desired. The machine is otherwise so simple as to need little description beyond the engraving.

The gearing can be driven by any hoisting or stationary engine. The idle pinion, with shaft and crank shown, may be used to operate it, but is intended rather for bringing the door into position with relation to hopper for loading. The iron car shown underneath the mixer, manufactured by the same firm, is made so as to dump freely from either side by simply raising the lever or trigger, shown on the rear end of car.

London Street Traffic.

The instructions which Maple & Co. have issued to their car men, to drive as closely as possible to the curb on the near side, and only to draw out when passing any other vehicle, could not, in the opinion of practical men, be rigidly applied to most of the thoroughfares of the city of London, where the traffic is the heaviest of any part of the metropolis. With respect to London Bridge, nevertheless, the Commissioner has laid down regulations by which there are four lines of vehicular traffic, two going one way and two the other. Vans and carts which are driven at a walk keep close to the curb on the left or near side, and the trotting traffic traveling in the same direction takes the off-side of the heavy traffic. There is no "drawing out" on the bridges, for there is never supposed to be occasion for it, unless a breakdown occurs. In the streets there is the general well-understood rule of the road for the heavy traffic to take the near side, leaving the crown of the road to the cabs and carriages, etc., but there is only one statutory regulation cognate to the subject, and this applies to the omnibuses, whose drivers are liable to be summoned if they take up or set down passengers other than on the near side. For the remainder of the users of the streets there is nothing in the way of prohibition. It is the circumstance that vans are constantly delivering or receiving goods from the merchants doors that makes it practically impossible to compel the drivers of heavy vans and carts while in motion to keep as closely as possible to the curb, for they would in that case be under the necessity of frequently pulling out in order to clear a sequence of stationary vehicles. An illustration of this matter is afforded by Cheapside, where there is theoretically room for four lines of traffic, but, in practice, one side, and sometimes both sides, of the road close to the pavements are taken up by carts at a standstill. About 15,000 vehicles pass through this thoroughfare, very often at a foot pace. There is the same pressure of traffic in Gracechurch St., which takes many of the heavy vans crossing London Bridge; but perhaps the busiest route is New and Old Broad Sts., where, in addition to cabs and carts, as many as 5,000 omnibuses journey to and from the Liverpool St. and Broad St. railway stations in the course of the day, in a double stream. Leadenhall St., which is the great East end artery, is hardly wide enough to take three lines of vehicles; but Holborn, which is patronized to about the same extent as Cheapside, can provide accommodation for five lines simultaneously, and hence offers the temptation to some drivers to break out of their rank to get ahead of others. Queen Victoria St. is another broad thoroughfare, but it is used less than Cannon St., which is narrower, and through which about 10,000 vehicles pass during each day. The tendency of traffic in the city of London is to show a steady increase from year to year, and 130 sergeants and constables are required to regulate it. In other parts of London, in broad thoroughfares such as the Edgware road and Bayswater road, the chief advantage of the instructions which have been issued by the firm referred to would be, it is thought, the diminution of the risk of collisions and the facilitation of the carriage traffic proper; but if the horses were allowed to decide the question for themselves, it would be found that they would choose the crown of the road in preference to the gutter, for when a van travels upon an incline, the effect is to throw an undue proportion of the weight upon two wheels instead of distributing it properly over the four, and this makes the traction harder.—*London (Eng.) Daily Telegraph.*

One Way of Obtaining Brine.*

The remains of the oldest and largest salt works in this country are at Syracuse, N. Y. These works have depended on the brine obtained from wells sunk in the State Salt Reservation, which brine ranges from 63 to 73% saturation.

The very existence of these salt industries depends upon their obtaining an ample and satisfactory supply of brine from some source, and efforts to obtain such a supply have long been made by the State and private individuals.

It was not until the Tully Pipe Line Co., through its president, W. B. COGSWELL, M. Am. Soc. C. E., had made numerous exhaustive and extensive examinations in the vicinity of Syracuse, that results were obtained which promise to revive the salt business in that locality, and make it once more the leading industry of its time in this country.

These investigations developed the fact that rock salt beds exist about 80 miles east of Warsaw and 20 miles south of Syracuse. Here are found two beds overlying each other, commencing about 1,200 feet, below the surface. The first bed is 43 ft. thick, then slate rock is encountered 25 ft. thick, then the second bed of rock salt 54 feet thick. The ground at this point is about 400 ft. above the Onondaga Lake at Syracuse, and 420 ft. below the Tully Lakes, which lie on the elevated plateau 3 miles further south. Twelve wells have been sunk, in three groups, and work is progressing for eight additional wells. The groups are about 1,000 ft. apart, and each group contains four wells, forming a rectangle with sides 150 × 400 ft. After the wells were sunk into the first salt bed they were double-tubed. The exterior tube is 6 ins. in diameter and the interior tube 3 ins.

Fresh water was first let into the interior tube, and after it was saturated it was forced up between the two tubes, as brine. The salt thus dissolved will create a subterranean reservoir, which, as it increases in size, increases in its capacity to saturate the fresh water furnished to the reservoir. Gradually the reservoir at each well will enlarge until, perhaps, in two years they will meet, forming a large reservoir at each group. These will enlarge, until the reservoirs at the different groups unite and an immense salt basin will be obtained with a rock cover 1,200 ft. thick. After a small basin is formed at each well, it is found better to receive the fresh water between the interior and exterior tubes, and deliver the brine through the interior tube.

It now only remained to determine the most efficient method of taking fresh water from a point 23 miles south of the reservoir at Syracuse at an elevation of 820 ft., converting it into brine, and delivering the brine in the most convenient manner for use at Syracuse. The solution of the problem was very simple. Dams, gate-house, screen-chambers, etc., were erected at the Tully Lakes to collect the fresh water at the elevation of about 820 ft. Three miles north, where the surface was at an elevation of about 400 ft., 12 wells were sunk as above described, 1,200 ft. into the bed salt. A wooden tank was built at each well, and an open surface reservoir, capacity 1,000,000 galls., was built about 30 ft. lower than the ground at the lowest well.

A 12-in. cast-iron pipe was laid so as to connect the Tully Lakes with the wells, and other cast-iron pipes connected each well through its wooden tank with the 1,000,000 gall. reservoir.

An automatic gate, regulated by a float in the reservoir, closed the inlet to the 1,000,000 gal. reservoir from the wells when the reservoir was full. When this gate on the inlet pipe at this reservoir closes the brine rises in the wooden tanks. A float in each tank closes a valve on the pipes, delivering fresh water to the wells when the tank is full.

At Syracuse another open surface reservoir of about 3,000,000 galls. capacity was built at an elevation of 112 feet. The two surface reservoirs, the one at Syracuse and the one at the wells are connected with 12-inch cast-iron pipes. The inlet to the Syracuse reservoir is also controlled by an automatic gate, closed by a float when the reservoir is full.

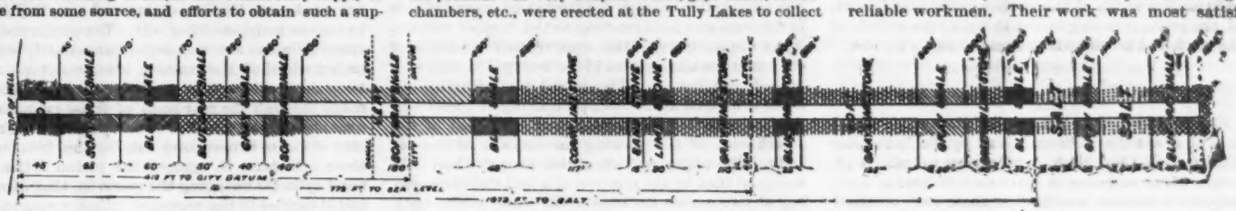
Hence, when the brine is drawn from the 3,000,000-gal. reservoir, the surface of the brine therein lowers and the inlet pipe slowly opens. This draft slowly lowers the surface of the brine in the 1,000,000-gal. reservoir at the wells, and the inlet gate on the brine pipe from the wells to the 1,000,000-gal. reservoir also slowly opens. This draft lowers the brine in the wooden tanks, and the gates on the pipes which deliver fresh water to the wells, controlled by floats in the tanks, in their turn slowly open. When the draft at Syracuse is shut off the reverse action takes place.

The whole movement being gradual and automatic all danger from water hammer is avoided. The necessary gates, air-cocks, blow-offs, etc., along the line are, of course, provided.

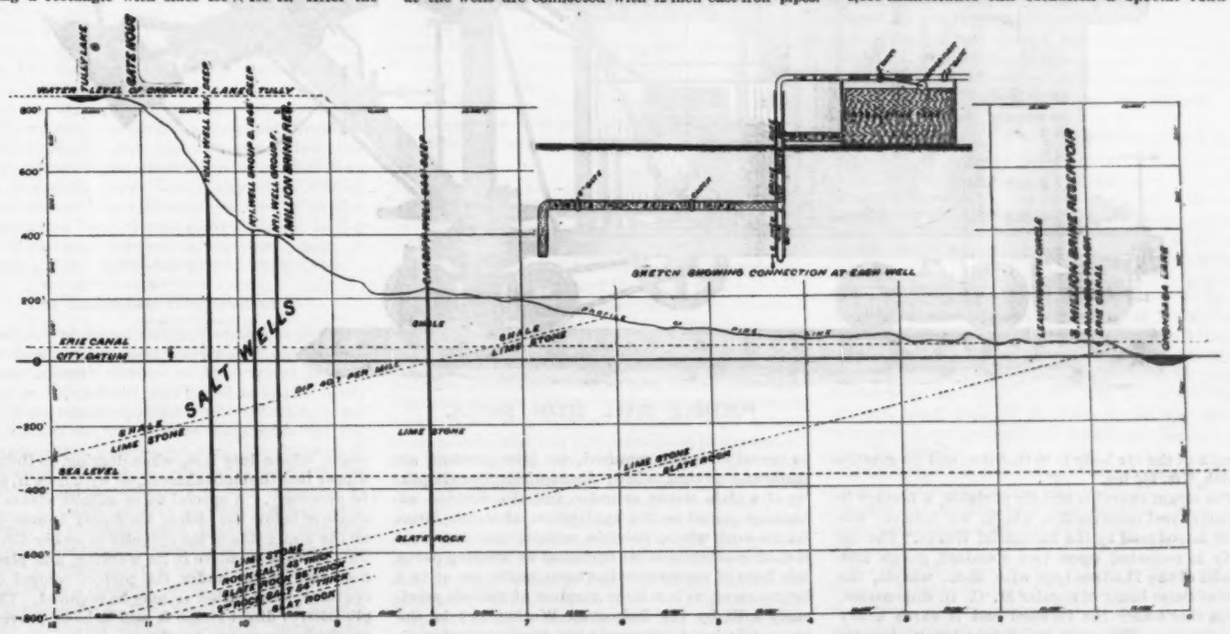
Construction commenced in May, 1889, and was completed in November of the same year. The plant now yields about 300,000 galls. of brine per day with about 90 per cent. saturation. It is expected that 95 per cent. saturation will eventually be obtained.

The paper then states that the line crosses the Onondaga Reservation and several of the gangs were composed entirely of Indians, who proved to be good reliable workmen. Their work was most satisfactory, with an Indian as a local foreman. It was necessary to treat them with more dignity than ordinary laborers. They would not tolerate abuse. They were not daunted by hard work, heat, nor wet weather. There was but little intemperance among them, and when paid off they deposited the large proportion of their money in the Syracuse Bank, sending it there by a committee from among themselves so as to lose as little time as possible.

All the work, except the sinking of the well, was performed under a percentage agreement. Notwithstanding the extraordinarily wet season, it was completed within six months, and 10 per cent. below the original estimate.



SECTION SHOWING STRATA AT THE WELLS OF THE TULLY PIPE LINE CO., TULLY, N. Y.



PROFILE OF PIPE LINE FROM TULLY TO SYRACUSE, SHOWING SALT WELLS, ETC.

The Ohio Country Road Law.

The Ohio road law, lately passed, provides that by a vote of the inhabitants any township having 4,500 inhabitants can establish a special road district. For this district three road commissioners are elected, who are authorized to levy a tax of not less than one nor more than two mills, for ordinary road work and repair, and a further tax of not more than four mills, in any one year, for grading, draining, macadamizing or paving roads.

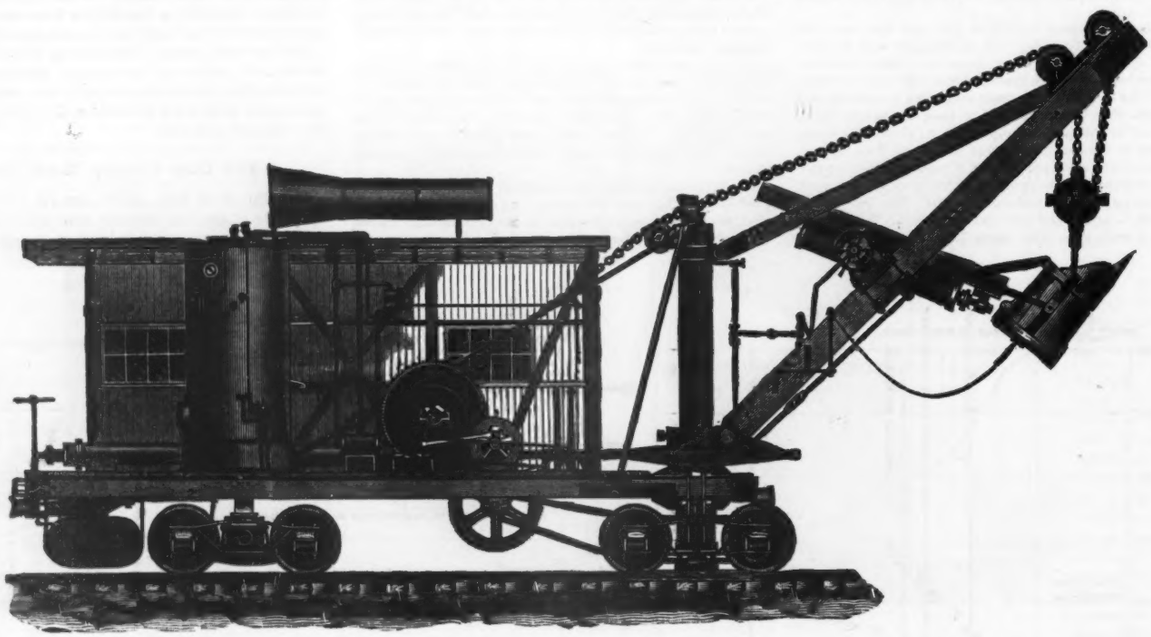
Whenever 30 freeholders in a special road district petition for a macadamized road, the Commissioners are required to order an election within 20 days, and if a majority vote in favor of the proposition the Commissioners are to proceed to have the road built. To defray the cost, bonds are authorized to be issued and sold at par by the township, bearing 5 per cent. interest and not to exceed $75,000 in amount, the principal payable in not less than 10 nor more than 30 years.

* Abstract of a paper by Chas. B. Brush, M. Am. Soc. C. E., presented at the Cresson Convention of the American Society of Civil Engineers.

The county is to construct all necessary bridges and culverts. The amount of bonded indebtedness on any road district is limited to $75,000, and the annual tax for new roads to 4 mills. The law provides that when a road is to be constructed it must be divided into sections of one mile each and properly specified and bids advertised for. The grades are limited to 5 degrees; the width of the roadbed to 30 ft., the width of the paving to 20 ft., the depth of the stone covering to be 15 ins. in the middle of the road, and no stone is to exceed 3 oz. in weight.

Improved Portable Steel Steam Shovel.

The accompanying illustration shows the latest form of steam shovel brought out by the Industrial Works, Bay City, Mich., with a view to include all recent ideas and also to cover such defects as have heretofore become apparent in their own or other makes. The shovel is constructed largely of steel, the car body being made up entirely of this material in the shape of I-beams, channels and plates, so framed as to give it great strength. All strains finally center in the car body, and provision is made, so far as possible, for the severest strains which may at any time be met with. The decking of the car body is oak plank, seasoned, tongued and grooved, and laid in narrow widths and continuous lengths. The total length of the car body is 29 ft. 8 ins., and its greatest width, 9 ft. 1½ ins.



PORTABLE STEEL STEAM SHOVEL.

The steam shovel is strictly portable, a feature in steam shovel construction which, we believe, was first introduced by the Industrial Works. The car body is mounted upon two standard gauge iron trucks of the Thielsen type with 33-in. wheels, the rear of these being of regular M. C. B. dimensions, while that under the forward end is extra heavy throughout. The position of this truck, directly under the crane post or mast, is manifestly its most advantageous one for receiving the strains when digging, with the least possible stress upon the car body. To afford additional stability in operation and to relieve this truck to a certain extent, side arms of steel are employed, which, attached to the car body, slope out and downward on either side to a point a little higher than its track level. The extremities of these arms are provided with powerful jacks, the whole arrangement being so designed that with the least possible amount of blocking, the front of the shovel may become rigid for work, while, on the other hand, in moving ahead into the embankment it may be again made ready for operation with the least delay. These arms may be swung up out of the way or entirely detached in transportation.

The center post or mast about which the crane swings is a wrought-iron column rolled in sections which are riveted together. The setting in the car body is the same as that which the Industrial Works has successfully employed upon something over 50 cranes, many of capacities as high as 35 tons, viz., massive upper and lower center plates, with a special arrangement of set bolts. The crane with this form of a center post is largely self-supporting, but additional strength is afforded by means of side braces and guy rods running to the further extremity of the car body. The compression members of the crane are simply two 15-in. heavy I-beams well braced and boxed. The wheel for swinging the crane is located at its base, permitting of direct connection with its heaviest members and also of the attachment of the slewing mechanism to the car body. The upper portion of this swing wheel is so designed that by the removal of a bolt and the working of two screws the base of the crane slides back over the wheel, the two lower members taking a position on either side of the center post, and the extremity of the crane is in this manner lowered for transportation, where necessary.

With this shovel the movements for propelling, hoisting, slewing the crane and working the dipper are all entirely distinct, in accordance with the general policy of this company in steam shovel construction. By so doing it is claimed the same nicety in operation is not required, no false motions are made and no time is lost. Recognizing the simplicity of a plain steam cylinder, and the decided advantage gained in the application of steam direct for its work where possible, without the intervention of gearing or other frictional or wearing parts, this form of mechanism has been made use of to a large extent, as in a large number of shovels previously built by the Industrial Works; but in the present design dimensions have been somewhat altered, the position of the important parts somewhat changed, and a different method of attachment to car and crane adopted, with a view to further improvement of the machine as a whole.

The steam supply is from an upright boiler 56 in. diameter, 9 ft. 3 ins. high, constructed throughout of flange steel. The tubes are set with copper ferrules and are at all times wholly submerged. The boiler is provided with lever shaking grates, an injector, and a pop safety valve. An iron water tank is suspended underneath the rear of the car and connected with the boiler.

The hoisting machinery for this shovel is of new design, claimed to combine in high degree simplicity and efficiency. It is of the single drum frictional type, with double cylinders. This engine has a reversible link motion, and with the use of but one steel pinion and its corresponding gear transmits power to the hoisting drum. It is quick and strong in its action, and is thought to have the least possible number of wearing parts. By means of a clutch and gear on the engine shaft motion is imparted to a countershaft under the car and thence to both axles of the front truck by means of endless chain. In this manner the shovel is self-propelling.

For swinging the crane two long steam cylinders are used, each 10¼ ins. diam., and attached directly to the car body on either side. The piston rods from these cylinders are connected immediately with the swing wheel of the crane by steel wire rope, and to keep these cables taut a similar back connection is made through the rear ends of these cylinders and over sheaves attached at these points. The admission of steam is necessary only to the front ends of these cylinders, if against the piston of the right-hand cylinder swinging the crane in that direction, and if carried to the opposite cylinder reversing the motion of the crane. Past experience indicates this to be a very simple, quick and effective method for slewing the crane of a steam shovel. These cylinders are suitably lagged and entirely out of the way under a low platform, which affords a means of easy communication between the forward and rear of the car.

The only remaining piece of mechanism is the steam cylinder suspended from and hanging in the crane, whose duty it is, when digging, to thrust the dipper into the embankment, or withdraw it, as may be necessary. A special valve admits steam either above or below the piston, the dipper handle sliding on the upper side of the cylinder in either direction. This valve is sensitive in its working, and places all necessary power under the perfect control of the operator, to be varied as may be required. This application of direct steam is said to have proven successful in every way for this use.

With a crane radius of 16½ ft. digging can be done out to a distance of 19 ft. from the center of the track upon which the shovel stands, and to a depth of 4 ft. below this track. These distances can be varied in special cases, with a different crane angle and stroke of cylinder, so as to meet any requirements. The standard dipper, of steel throughout, has a capacity of 1¼ cu. yds., is provided with an automatic dumping latch, has forged iron bail and other connections, and is raised and lowered with a 1 in. chain. The car is covered with a neat wooden cab, which serves simply as a protection to boiler and machinery, in no way supporting any important part.

The Industrial Works has already completed several of these shovels and has a number of others under way for different railroad companies. A recent extensive shipment of this class of machinery

was made to Greytown, Nicaragua, consigned to the Nicaragua Canal Construction Co. From the large experience and known high standing of this concern in its specialties, we judge their latest form of shovel to be in all respects an excellent tool.

Granite and Macadam Pavements in Paris.

According to the *Zeitschrift fur Transportwesen*, there will be more attention paid to the granite and macadam pavements in Paris during the coming year than has been the case for some time. Property holders in the suburbs have complained that more than a just amount of the appropriations for streets is spent in laying wooden and asphalt pavements in the heart of the city. The authorities have accordingly resolved to repair or renew all the outlying streets.

The chief improvement in the granite pavements is the concrete bed that is now used as a foundation for the blocks wherever the traffic is of any great volume. The new pavements are prepared in the following manner: The old blocks and the underlying sand is removed and the ground then brought to the proper grade and heavily rolled. On this surface a concrete layer of about 8 ins. is placed and the whole covered with 3 to 3.5 ins. of sand. On this sand are laid the rectangular blocks at right angles to the center line of the street. Between the rails of the tramways and for 1.5 ft. on either side the joints are filled with cement. The entire upper surface is then covered with sand, sprinkled with water and rammed by hand. More sand is now scattered over the surface, and after two or three days the street is opened to traffic. Several layers of sand are scattered over the pavement during the first few weeks of its use.

When broad streets are being repaired in this manner it is usual to close but one side of the street at a time, thus allowing a limited traffic to be carried on. The pavements are not popular on account of their noise and will be restricted to the suburbs.

Macadam pavement is restricted to streets where few vehicles pass and to drives in the public parks, such as the Bois du Bologne. In repairing such roads of late years, it has been customary in some places to mix old asphalt fragments with the broken stone. The results, as regards wearing qualities, show little improvement over the unmixed stone; the great advantage of the process lies in the fact that such a pavement keeps remarkably clean during dry weather and does not become so muddy as the true macadam style during rainy seasons. In the middle of summer, however, an unpleasant odor is given out and the surface has a dirty black color.

The Smokeless Gunpowders.

The secrecy of manufacture of smokeless powders by the different European Government officials has given an unusual interest to the various patents relating to this subject, and it will be in the recollection of our readers that Sir Frederick Abel, in his recent lecture on "Smokeless Explosives" at the Royal Institution, pointed out that the question of the ultimate adoption of smokeless powders for military and naval purposes was only a matter of time. The so-called "amide powder," formed from a mixture of potassium and ammonium nitrates, was at one time the most important of these new explosives. Unfortunately, it was found to deteriorate when stored in a confined space, and hence a new material was desired. The French produced a powder for their Lebel rifle which contained picric acid, and last year it was believed that the manufacture of this explosive in France would confer a considerable benefit on the manufacturers of picric acid, as this material had hitherto few commercial applications. At present the smokeless powders which give the best results are those obtained from different nitro-celluloses or modifications of gun-cotton. Nobel obtained from gun-cotton by dissolving it in nitro-glycerine, a powder which was both smokeless and unaffected by water, but as this explosive gives no solid products when detonated, there seems to be a difficulty in using it for the purpose for which it was devised, since no lubricant is produced in the bore of the gun to reduce the friction of the metal on metal. The composition of this Nobel powder is as follows:

Nitro-glycerine	100
Nitro-cellulose	50-200
Camphor	10-25

The camphor is first dissolved in the nitro-glycerine, and then, after the addition of 200-400 parts of benzene or amyl acetate, the nitro-cellulose is stirred into the solution. On evaporating the benzene at a temperature of 50°-60° C., the explosive is left in a gelatinous sheet, which can subsequently be cut into small cubes. As camphor is a very volatile body, the explosive made in this way is not of uniform composition; and more recently M. Nobel has proposed a mixture of 50 parts nitro-glycerine with 50 parts of dinitro-cellulose, the latter being made to dissolve in the former by means of benzene. He claims for this modification of his original powder that it is of uniform composition and permanent in moist air. The Nobel powder is of a brown color, and is one of the smokeless explosives which has recently been experimented upon by the German Government.

The French smokeless powder already alluded to is known under the name of "poudre vieille," and has been in use in the French army since 1887, but the secret of its composition has been so well guarded that no other Government has been able to produce a similar powder. It possesses many good qualities, and has been kept for a considerable length of time without undergoing any deterioration.

In Belgium the powder manufactory of Wetteren have produced a smokeless powder by dissolving nitro-cellulose and barium nitrate in amyl acetate. It is known as "No. 32," and is sent into the market in thin sheets resembling brown paper. The Austrian firm of Wolf & Co. have also introduced one of these new explosives. Their compound consists of gun-cotton which has been partially dissolved in acetic ether or nitro-benzene, and subsequently dried by driving off the solvent at a low temperature. In this way each particle of gun-cotton is coated with a glazed surface, which retards its decomposition and renders it available for use in firearms.

Maxim has also patented a modificatien of gun-cotton, which is obtained by first saturating the cotton with acetic ether vapor, when it can be compressed into any desired shape, and subsequently obtained in granules or powder by gently evaporating off the solvent.

The well-known Hengst powder is obtained by nitrating straw, and then digesting the nitro-cellulose so formed in a hot bath of the following composition:

Water	1,000
Saltpetre	12.5
Potassium chlorate	3.125
Zinc sulphate	12.5
Potassium permanganate	12.5

After this treatment for some hours the material apparently absorbs some of the salts present in the water, and when dried by pressure can be obtained in the form of a fine powder. In an amended patent of last December the patentee has made some slight alterations in the method of manufacture. In America, gellite, or emmensite, so called from Dr. Emmens, of New York, is now being experimented with. It is a nitro-cellulose saturated with ammonium picrate, and was first introduced to the American market in 1888. The nitro-cellulose used in its manufacture is prepared from paper, care being taken that the nitro-product does not contain any trace of free nitric acid. It is then warmed with picric acid, and a current of ammonia gas passed through the liquid to convert the acid into the ammonium salt. Other powders of lesser importance containing nitro-cellulose have been patented by Turpin in 1888 and Gaens in 1889. The Gaens powder is being manufactured at Hamburg; it has the following composition:

Nitro-cellulose	25
Potassium nitrate	60
Ammonium ulmate	50

This mixture is dissolved in acetic ether, and the mass compressed and granulated; it is then carefully dried. The ammonium ulmate, which is the novel ingredient in this formula, is obtained by digesting peat or turf with ammonia; the ulmic acid present in the vegetable mold is thus dissolved, and from the solution so obtained the ammonium ulmate is prepared. It is difficult to see what especial virtue this material has over other organic acids of more definite constitution.

In this country, although apparently the official experiments have not been sufficiently decisive to warrant a new departure of any magnitude, considerable progress has been made. Among the earlier patents we find that Sir Frederick Abel, in 1886, laid claim to a smokeless explosive consisting of nitro-cellulose powdered and dried, and mixed with one-tenth to one-half its weight of dried ammonium nitrate. The mixture is then moistened with petroleum ether and molded into small cubes, which are finally dried by gentle heating. The powder is then treated with a solvent which attacks the surface of the nitro-cellulose. On again drying, each granule is found to be coated with a superficial layer of varnish, which protects the ammonium nitrate from absorbing moisture from the air. Sir Frederick Abel has also produced an explosive named "cordite," which is similar to that patented by M. Nobel, but is obtained in filaments of a light brown color.

Johnston & Borland have also patented an explosive which is obtained by dissolving nitro-cellulose in a solution containing camphor. After gentle heating the solvent is driven off, and an intimate mixture of the nitro-cellulose with the camphor is obtained. On heating this mixture in a closed vessel, the camphor being volatile produces a sort of glazed film on the surface. which renders the mass hard and suitable for use.

More recently, Colonel Noble has succeeded in producing at the gunpowder factory at Waltham Abbey a new smokeless powder, termed "Walthamite," which has already given satisfactory results when fired in the new magazine rifle at the Government ranges at Enfield Lock. Its composition is at present not made known, but it is understood that peat is used in its manufacture, and that therefore it may contain as one of its ingredients ammonium ulmate similar to the Gaens powder, to which we have already alluded.—*Industries.*

The Boston Sewerage System.

There will be two separate systems of sewerage in Boston, the north metropolitan system, embracing the towns of Woburn, Stoneham, Winchester, Medford, Melrose and Everett, and the cities of Cambridge, Somerville, Malden, Chelsea, Charlestown, and parts of East Boston; and the south metropolitan system, embracing Waltham, Newton, Watertown, Brookline, and the Brighton district of Boston.

The northern system begins near the boundary line between Stoneham and Woburn, and will include the Mystic Valley sewer, extending from Woburn through Winchester into West Medford. The line will be 17.5 miles long. Though the sewer begins 48 ft. above low tide, there will be four pumping stations, viz.: At the junction of Alewife Brook and Mystic River, where the West Cambridge sewage must be pumped into the main branch; in East Somerville, where the united sewage of Cambridge and Charlestown must be lifted; in East Boston, where the main sewer crosses Chelsea River; and on Deer Island, where the whole flow must be lifted for discharge at the outlet, which will be in the tidal current, more than 50 ft. deep. Four sections of this system, embracing 17,100 ft., are now under contract for $448,000.

That part of the southern system between Waltham and the intersection of Huntington Ave. and Camden St., Boston, will cost $804,000. Two sections, embracing 6,700 ft., have been let for $104,900.

The estimated cost of the whole work of trunk lines and main branches, with outlet, with pumping machinery and appliances for disposing of the sewage of the north metropolitan district, when the population is 290,000, which is the estimated population in 1892, inclusive of the intercepting sewers of Cambridge, Charlestown, Chelsea and East Boston, is $4,159,500.

Boston's Latest Water Supply.

The problem of a future water supply for Boston, Mass., is growing rapidly in its proportions and is now constantly before the water commissioners. The new Ashland Basin No. 5, now under construction, will solve it in part, but the estimates of City Engineer JACKSON show that the maximum capacity of the Cochituate and Sudbury supplies, developed to their fullest extent, is only 40,000,000 galls. per diem on a dry season basis. Of this supply 35,000,000 galls. is in use.

To complete the development of the system avail

able, three branches not yet utilized are to be considered, says the Boston *Herald*, viz.: The Whitehall pond and basin below, having a daily capacity of about 3,000,000 galls.; the Stony Brook basin, or basins, with a storage capacity of about 1,110,000 galls., and the Indian Brook basin, called No. 5, furnishing a daily supply of 4,500,000 galls. Of these possible additional sources, which must be brought into service in order that Boston's main water supply shall be completely developed, the Indian Brook basin at Ashland is now begun Three years ago a loan for purchasing the land for this basin (No. 5) was authorized, but for 2¾ years the water board was powerless to go on with the work of its construction, owing to the failure of the city council to appropriate any sum whatever for the purpose. At last, however, the funds were provided, and this spring the work of construction was begun in earnest.

Ashland basin (No. 4) is a beautiful sheet of water, formed by Cold Spring Brook, and has a dam of 1,800 ft. long, nearly 300 ft. wide at the base, with a cemented stone core 8 ft. thick. Its contents is 1,122,000,000 galls., and it gives a daily supply of 4,500,000 galls. The elevation of flow line is 214 ft. above marsh tide.

Indian Brook basin, or No. 5, lies in the towns of Hopkinton and Ashland, but the dam is to be stretched in the latter town between two hills, 1,500 ft. apart, and will have about 90 ft. for its greatest depth. Its construction will be the same as that at basin 4. The elevation of the basin at grade is about 295 ft. above marsh tide, and 50 ft. above the valley. The area to be flowed is 235 acres, of which one-half will have to be cleared of trees and the loam removed down to gravel bottom. A large number of teams and 150 men are already at work preparing the foundation for the dam. A large section has been "skinned," and most of the bowlders blasted out. The trench for the cemented core to the dam will be dug at once. Most of the material for the construction of the dam is right at hand. When completed the territory will be flooded back to a distance of about two miles, and three roads flooded, in place of which new locations will be made and highways constructed; in fact, that is now being done. Borings have been made by Supt. DESMOND FITZGERALD by a diamond circular hollow drill on the site of the dam.

THE BROOKLYN BRIDGE BOARD OF EXPERTS to reconsider the question of terminals, and in effect decide whether the trustees were sensible in rejecting and acting directly contrary to the recommendations of the last Board of Experts, has been completed by the appointment (by Mayor CHAPIN, of Brooklyn), of Prof. GEORGE W. PLYMPTON, of the Brooklyn Polytechnic Institute. Prof. PLYMPTON graduated at Troy in 1847 and has since led a very active professional life. The other two members are SAMUEL SPENCER, late Vice-President of the Baltimore & Ohio R. R. (appointed by Mayor GRANT of New York), and C. W. BUCKHOLZ, Engineer of Bridges and Buildings, New York, Lake Erie and Western R. R., appointed by President HOWELL of the Board of Trustees. All of these gentlemen are members of the American Society of Civil Engineers, well qualified for their responsible duty, so far as can be judged, and above suspicion of bias The former Board of Experts, which reported in February, 1888, in favor of Mr. A. M. WELLINGTON'S plans for the terminals, consisted of WALTER KATTE, Chief Engineer N. Y. C. & H. R. R. R.; JULIUS W. ADAMS, Ex. President Am. Soc. C. E., and JOSEPH CRAWFORD, Superintendent of the New York Division of the Pennsylvania R. R.

THE LATEST ADVICES FROM NICARAGUA, up to June 20, are that work on the railway into the great cut is advancing well under Mr. C. P. TREAT, contractor, about 1½ miles of track being laid and about 3 miles more graded waiting for delivery of rails. Ties of native wood made by the natives are used, and the swampy places are being corduroyed to get the track over, pending permanent trestles. About 300 men are at work, and more urgently wanted. Work on the jetty is also progressing, but for lack of lighters and tugs to unload schooners of material is somewhat impeded. Low malarial fevers are causing some trouble, but no deatbs result, and recovery is rapid when placed under proper sanitary conditions, while it appears that these fevers occur at all only among those who persist in drinking the swampy waters. It was inevitable that there should be some trouble of this kind in constructing across the 12 miles of coast flats, and that there is no more of it is an encouraging feature. There is no yellow fever whatever, but as many as 80 at once have been in the hospitals while 300 were at work. We look to see this proportion steadily and rapidly decrease as the work and season advances and administration becomes systematized.

PROPOSALS FOR THREE 8,500-TON CRUISERS have been called for by the Navy Department at Washington. The vessels are to cost, exclusive of armament, not more than $4,000,000 each. Proposals may be made for a whole vessel or for either the hull or machinery. The vessels must attain a speed of at least 15 knots for four consecutive hours. The hull is to be of steel not sheathed. The armor on the side, for protecting the water line, will have a maximum thickness of not less than 18 ins. and a mean depth of 7 ft. The transverse armor at the ends of the belt will be not less than 14 ins. in thickness. Redoubts and turrets will have armor not less than 17 ins. thick. The side, from armor belt to the main deck, will be protected by not less than 5 ins. of steel armor. Coal is to be carried back of this casemate armor. An armored deck, not less than 3 ins. thick is to extend forward and aft from the ends of the armor belt, being curved down on each side to meet the side of the ship below the water. Over the side armor belt this steel deck will be not less than 2¾ ins. in thickness.

Each vessel will carry powerful guns, aggregating in all 631 tons, including four 13 in. breech-loading rifles of 60 tons, and four of 56 tons each, beside 60 other guns, ranging from nearly 10 tons downward. It will require 306 tons of ammunition to complete the vessel's fighting outfit. The 13 in. guns are to be protected by 17 ins. of armor and the 6 and 8 in. guns by shields, and, in addition, by barbettes carrying 4 and 6 in. armor. Twelve torpedoes, seven of the tubes to be above water will be carried. Each vessel will also have a large electric light plant. The crew will be 30 officers and 430 men.

THE KINGSTON DRY-DOCK, now under construction at Kingston, Ont., is being built in a most thorough manner. The dock proper is 280 ft. long, 38 ft. wide at the bottom and 80 ft. wide at the top, 48 ft. wide at the opening and 4 ft. deep, and is being quarried out of the solid rock. The quarrying is nearly completed, only about 1,000 cu. yds. remaining to be removed. The sides of the dock are built like stairs with ashler masonry and conform in shape to a boat's hull. The floor will be made of stone about 3 ft. thick and lined with 18 in. of cement. The dock will be provided with a rudder well and with drains to carry away the water not removed by the pumps. It is expected that the work will be finished by October, 1891.

PLANS FOR THE ELLIS ISLAND IMMIGRANT STATION have been prepared by Supt. JOHN W. MARSHALL, and are now being considered by the government authorities. According to the plans, the area of Ellis Island, now about 2¾ acres, is to be increased another acre by filling. The island is oval-shaped, with an indentation on the south side, facing the Narrows. Col. MARSHALL proposes to dredge a basin there first of all that will be 800 ft. long and 200 ft. wide. This will afford an approach to the island with a depth of about 30 ft. The basin will be sheltered by cribwork, leaving a large entrance and forming a breakwater. The cribwork along the island will make a wharf 800 ft. long, where the immigrants will be landed. The main part of the depot will be 200 ft. long and 200 ft. wide. It will be supplemented by two wings, which, with the main hall, will present an unbroken front of 490 ft., but running back about 80 ft. The middle structure will be two stories high and the wings one. The building will be constructed of wrought iron columns, with walls of wood between them, and are estimated to cost from $200,000 to $225,000.

ANOTHER NEW OCEAN CABLE from Halifax to Bermuda is about completed. The company laying the cable has been heavily subsidized by the British Government, which desires the cable for strategic reasons.

THE AQUEDUCT COMMISSIONERS have accepted Section 6 of the new aqueduct from the contractors O'Brien & Clark. The Controller was authorized to pay the final estimates, less $20,000 retained for damages and penalties. The Commission accepted from the same firm Shaft 16½, and from Brown, Howard & Co., Shaft 11, as well as the roadwork in front of the Croton Dam from Smith & Brown. The resolutions for final payments to Brown, Howard & Co., and O'Brien & Clark for Sections 2, 3, 4, 5, 7 and 8, less the penalties named, have been passed. The announcement has been made that arrangements for filling the Central Park reservoirs by means of the new waterway were going ahead satisfactorily, and that the chances were still bright for turning on the water on July 13 or 15.

A DAM IS PROPOSED AT TOPEKA, KAN., on the Kansas river, by Anthony, Holmes & Co., who are trying to secure subscriptions of power users to take power at $30 per H. P. per year, to the amount of 3,000 H. P. As the total cost of the dam and electric plant to distribute the power is estimated at $1,000,000 and from 6,000 to 10,000 H. P. can be developed, it will be seen that the projectors of the enterprise have a very profitable scheme. A good deal of difficulty seems to be experienced, however, in securing subscribers for power, and the success of the enterprise is still problematical.

CONSIDERABLE OPPOSITION TO THE PROPOSED "LAKE FRONT" site for the Columbian exposition at Chicago has developed. It is urged that it would take at least 18 months to complete the filling, and the time is even now too short for the erection of really suitable buildings. Beside, the expense is a great obstacle in the way. Many members of the National Commission think the available area is too small. A scheme which is meeting with some favor is to have the exposition divided, a part being on the lake front and the remainder at Jackson Park, with a four-track railway connecting the two and free to all those inside the grounds.

THE STREETS OF NEW YORK CITY were opened 19,371 times during 1889 by the gas, electric light, subway, and steam heating companies. Openings were made by the different companies as follows: Consolidated Gas Co., 10,132; Standard Gas Light Co., 2,825; Equitable Gas Light Co., 2,596; New York Mutual Gas Light Co., 683; Edison Electric Illuminating Co., 1,827; Consolidated Telegraph and Electric Subway Co., 851; New York Steam Co., 457. Total, 19,371. The rare number of openings, however, gives a false idea of the relative disadvantage and inconvenience. The steam company's openings, especially, while few in number, were for the most part large, and all in the most crowded business streets. The other openings were more for house connections.

A HIGHWAY LAW FOR TEXAS has been recommended by the Texas Association of County Judges A competent and properly paid road supervisor for each county, with proper assistants, is among its prominent features.

ASPHALT DEPOSITS IN KENTUCKY are to be worked by a company of Boston capitalists, according to press reports. The deposit is situated near Ferguson Station, on the Louisville & Nashville Railroad, in the northwestern part of Logan County. It is stated that it can be mined and delivered in New York at a cost of $6 per ton, which is certainly important if true. A branch railroad, about 10 miles in length, is said to be planned to reach the asphalt deposits.

THE LARGEST GUN EVER MADE has been sent from the Krupp works at Essen to Russia. It is of cast steel, weighs 2,135 tons and is 40 ft. long with a caliber of 13.5 ins. It will fire two shots per minute.

THE REDEMANN-TILFORD STEEL REFINING PROCESS has been tested at the works of the Troy Steel & Iron Co., Troy, N. Y., and, it is said, with very promising results. By this process low steels are converted into high grade metal, and it is claimed that old Bessemer rails can be turned into the best razor steel. The process is certainly an important one if the claims made for it can be substantiated.

A COMMON THEORY OF THE "DIVINING ROD" is that it is a manifestation of personal magnetism and that the rod itself plays a very small part in the operation. Believers in this theory will find confirmation of

their position in the case of FREDERICK RODWELL, of Newcastle, England, described in a recent number of *The Colonies and India*. This youth, 15 years of age, is said to possess the power of accurately locating underground sources of water and mineral veins. In a trial in the district of Dufton Fells he indicated correctly the position of several known mineral veins and then indicated a new one in an untried district, which was found to be strong and promising. It is further stated that on taking hold of the boy's hand as soon as a position over the vein was reached a strong current of electricity was felt which continued as long as the boy remained standing over the vein.

ELECTRICITY IS NOT DUTIABLE according to the U. S. Custom House authorities. A member of a water power company, desiring to transmit electricity from Canada across the Niagara River into this country, wrote to Assistant Secretary TICHENOR to ascertain if it was a dutiable commodity. The latter replied that as it was an invisible agent, possessing no substance, it was not liable to duty.

THE AMERICAN BOILERMAKERS ASSOCIATION began its third annual meeting in New York City July 1. Above 100 members were present. The secretary's report showed the association to be in a prosperous condition, and recommended the formation of an American Boiler Manufacturer's Insurance Co., believing that the existence of such a company would tend to make the manufacturers more careful to do only the best possible work.

CONSTRUCTION NEWS.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

Altoona & Wapsononock.—F. G. Patterson, of Altoona, Pa., President, writes as follows:

This road is projected to run from Altoona, Pa., via Fairview, Miller's Gap and Sononock to Fallen Timber, a distance of 15 miles. The preliminary survey of the whole line has been completed, and about five miles have been graded ready for tracklaying. The work is generally light. The right of way has been all secured. The principal business of the road will be in coal and timber. McGovern Bros., of Tyrone, Pa., have the contract for building the road. It is expected that tracklaying will begin in about 20 days, and the road completed and in operation in two months. The company was chartered in May, 1890. F. L. Faries, of Bellwood, Pa., is Chief Engineer, and H. J. Davis is Secretary.

Cleveland, Cincinnati, Chicago & St. Louis.—President Ingalls is quoted as saying:

We have concluded to build a line from Columbus to Springfield, and will have it completed this fall. We have tried for six months to make a trade with the owners of the line now running from Columbus to Springfield but have not succeeded, and the only thing that now remains for us is to build. The line will be only about 40 miles in length and easily constructed. It has been a disadvantage to us not to have the State capital on our through line, but we will soon have one now."

Western Maryland.—This company has made an official statement of its plans for its proposed extensions. It is proposed to construct a branch line about 29 miles in length, from the Baltimore & Harrisburg Railway, a division of the Western Maryland, through the city of York to a connection with the Philadelphia & Reading Railroad at Chickies, near Marietta, in Lancaster Co., Pa. also a branch line 20 miles in length from Thomasville, upon the proposed York and Chickies line, to Bowmansdale, upon the Harrisburg & Potomac Railroad, about 8 miles west of Harrisburg, and to operate its trains to and from Chickies and Harrisburg under contracts already made with the Harrisburg, including the use of all Philadelphia & Reading facilities at Harrisburg, the Philadelphia & Reading Company now having a large force employed in bridging the Susquehanna River and completing, in the name of the Harrisburg Terminal Company, the unfinished portion of the Harrisburg & Patomac Railroad between Bowmansdale & Harrisburg. The plans also cover an extension of the main line of the Western Maryland Railroad, under the name of the Potomac Valley Railroad, from a point near Williamsport, Md., to a point upon the main line of the Baltimore & Ohio Railroad near Cherry Run, W. Va., in connection with which a contract has also been entered into with the Baltimore & Ohio Railroad Company for a full interchange of business,

Rome, Watertown & Ogdensburg.—This company is purchasing right of way for its proposed extension to Buffalo, N. Y. The line will run from a connection with the New York, Lake Erie & Western and the Delaware, Lackawanna & Western Railways at Buffalo Plains, to a connection with the R., W. & O. R. R., at Suspension Bridge.

Lehigh Valley.—This company has filed a mortgage of $15,000,000 with the Girard Life Insurance, Annuity and Trust Co., of Philadelphia, Pa. The money is to be used for completing the roads in process of construction and making improvements on the old line.

Phillips & Rangeley.—About 600 men are now at work on this Maine road, and the number will be increased to 1,000 at once. The road is to be completed by Sept. 15.

Baltimore & Ohio.—This company will expend about $400,000 this summer in improving its Pittsburg terminals. A new freight station will be built, covering an entire block along the Monongahela River.

Pittsburg, Akron & Western.—James D. Callery, President of this company, is reported as saying that 56 miles of the line between Delphos and Curry is now in operation, and of the remaining 109 miles between Akron and Curry, about 40 are graded, and tracklaying has been commenced. It is expected that the remaining 69 miles will be completed and that the whole line will be in operation by Nov. 1.

Projects and Surveys.

New York, Bridgeport & Eastern.—The Connecticut Railroad Commissioners have decided that the location and franchises of this road are in accordance with the laws of the State. The road will extend from the New York State boundary at Port Chester to New Haven, Conn. It will avoid all grade crossings of highways and intersecting railroads, and all the bridges along the linewill be of stone or iron. The road will be 45 miles in length, and the cost of construction will exceed $5,000,000. The directors of the company are: Henry R. Parrott, of Bridgeport, Conn.; George Cowles, Edward K. Lockwood, and Clarence B. Coolidge, of Norwalk, Conn.; Andrew L. Whiton, of Bridgeport, James D. Mowry, of Norwich, Conn.; George E. Spare and L. B. Adams, of New Haven; Thomas N. Brown and Charles D. Ingersoll, of New York; William Rotch, of Boston; George S. Forbush, of Brookline, Mass., and W. W. Douglas, of Providence, R. I. The capital stock is fixed at $6,000,000.

New York, Ottawa & Northwestern.—A press dispatch says:

A project is under way for the construction of a direct line of railway from the city of New York to Ogdensburg, St. Lawrence Co., and thence by bridge over the River St. Lawrence to the Dominion of Canada. The proposed railway includes charters already obtained for roads, with extensions of time granted for the completion of the same until 1896. A charter for the New York & Northern R. R. Co. was passed April 28, 1866, and authorizes the company to construct a railway between the city of Schenectady and Ogdensburg. That portion of the line between Schenectady and Albany has been surveyed, and the remainder of the route, between Albany and New York, was surveyed by the late Charles W. Wentz for the New York & Albany R. R. Co., a company which was organized several years since under the general law. The proposed Albany & New York R. R. skirts the west shore of the Hudson River to Kingston, and from the latter place an interior line will be taken to Hoboken, N. J., and thence by ferry to New York. The several lines will be consolidated under the name of the New York, Ottawa & Northwestern Ry. Co.

Baltimore Belt.—Proposals will soon be asked for the construction of this road. The bids will be upon the entire work or sections of it. There will be four sections. The first section is to be 2 miles long, and is to extend from Bay View Junction to Belair road, the second from Belair road to Guilford Ave., 1¼ miles; the third from Guilford Ave. to a point near Mt. Royal Ave., 1¼ miles, and the fourth from Mt. Royal Ave. to Hamburg St. These proposals are not to be advertised, but bids on the work will be asked of well known contractors, and the lowest will be accepted. Samuel Rea is Chief Engineer.

Providence, Ponaganselt & Springfield.—Surveys are being made to ascertain the probable expense of building this proposed road from Providence, R. I., to Springfield, Mass.

Croton Valley.—It is announced that the contracts for building this road will be let soon. The surveys have been completed. The road is projected to run from Croton Point, Westchester Co., N. Y., to the Connecticut State line, near Ridgefield, a distance of about 25 miles. T. L. Moore, of 224 West Twenty-fourth St., New York City, is Chief Engineer.

Columbus, Brownstown & New Albany.—Incorporated in Indiana to build a railway from Columbus to New Albany, Ind., via Brownstown and Salem, with a branch from Salem west to French Lick Springs.

Pennsylvania Midland.—The officers of this company, whose incorporation was noted last week, are: President, John Jermyn; Treasurer, Geo. B. Jermyn, and Secretary, S. B. Mott, all of Scranton, Pa.

SOUTHERN.—Existing Roads.

Empire & Dublin.—The contract for grading the extension from Hawkinsville to Grovania, Ga., has been let to Patrick Keilly, of 11 Cornelia St., Atlanta, Ga., and the work is to be completed as soon as possible.

Nashville, Chattanooga & St. Louis.—This company has purchased the Tennessee & Coosa R. R., and will extend it from Attala to Huntsville, Ala. The company will also construct an extension from Dunlap to Pikeville, Tenn. The company will make an issue of its first mortgage 5% bonds to pay for the extensions.

Savannah, Americus & Montgomery.—The contracts for the line from Louvale to Montgomery, Ala., are being let. King & Hannon, of Montgomery, have the contract for 90 miles of the line.

Western & Atlantic.—This road has been leased to the Nashville, Chattanooga & St. Louis R. R. for 29 years from Dec. 27, 1890. The annual rental is $35,001. The Richmond & West Point Terminal Co., bid $35,000.

Charleston, Sumter & Northern.—A. A. Howlett, General Manager, is reported as saying that the contract for the bridge over the Pee Dee River had been let to the Phœnix Bridge Co. The contract for the trestling over the Pee Dee swamp has been awarded to Williams & Couly, and for the grading from Sumter to Bennettsville to Pringle & Co. Work is already in progress, and it is hoped to have the entire line in operation by the end of the year.

Projects and Surveys.

Tampa, Gulf & Northwestern.—Incorporated in Florida to build a railway from a point on the Georgia State line in Jackson Co. east and south to a point in De Soto Co., with a branch to Ocala, in Marion Co. The total length of the line will be about 450 miles. Among the incorporators are: E. E. West, Madison, Fla.; W. F. Penniman, Brunswick, Ga., and Edward Lewis, Tallahassee, Fla.

Atlanta & Birmingham.—This company will apply for a charter to build a railway from Atlanta, Ga., to a point on the Alabama State line in Heard Co. The incorporators are: E. M. Blalock, B. H. Hill, Walker Dunson, and Arthur Hutchinson. The principal offices will be at Atlanta, Ga.

Western Alabama & Mississippi Valley.—This company has been organized to build a railway from Mobile, Ala., via Wesson and Port Gibson to Monroe, La.

Albany, Boston & Florida.—This company has been organized to build a railway from Albany to Boston, Ga., 90 miles. Among the incorporators are: J. W. Taylor, D. R. Blood, and others of Boston, Ga.

Smithsonia & Dunlap.—The officers of this company are: President, Jas. M. Smith; Treasurer, C. A. Stephens, and Secretary, Frank Howard. The office of the company is at Smithsonia.

Bristol, Elizabethtown & North Carolina.—The Unaka Construction Co., it is stated, has secured the contract for the construction of this road.

Chattanooga Southeastern.—This company has made an application for a charter to build a railway from Chattanooga, Tenn., to Atlanta, Ga. Among the incorporators are: W. A. Robinson, of Atlanta, J. T. Robinson, of Athens, Ga., and E. R. Hurlburt, of Chattanooga.

Albany, Florida & Northern.—Contracts are reported let for building this Georgia road. Nelson Tift, of Albany, Ga., is President.

NORTHWEST.—Existing Roads.

Peoria, Springfield & St. Louis.—W. S. Hook, of Jacksonville, Ill., writes as follows:

The P., S. & St. L. Ry. Co. was organized for the purpose of consolidating with the Chicago, Peoria & St Louis Ry. Co., in order to obtain authority to continue the latter road into East St. Louis, Ill. The consolidation was effected in July, 1889, and since then the work of construction from Litchfield south has been carried on. Track has been laid to within a short distance of Edwardsville and will be completed to that city in a few days. The work of grading and bridging between Edwardsville and East St. Louis is now in progress.

Winona & Southwestern.—The contract for grading an additional 22 miles of this road has been let to Dennis Galligan, the work to be completed by Aug. 15. Thirty-three miles of the line are now under contract and it is expected that the contracts for further extensions will be let within a month. The contractor is now pushing work on the line. D. M. Wheeler, of Winona, Minn., is chief engineer.

Chicago, St. Paul, Minneapolis & Omaha.—About 2,000 men are now at work on the line between Neillsville and Wausau, Wis. The route will penetrate a fine timber region.

Pacific Short Line.—About 100 miles of track have been laid on this road from Sioux City west. The line will be completed to O'Neill, Neb., in a few days and as soon after as possible construction will begin on the line west from that place.

Chicago, Rock Island & Pacific.—This company has let the contracts for grading the line from South Omaha to Lincoln, Neb., and work is now in progress.

"Qu'Appelle Long Lake & Saskatchewan R. R. & Steamboat Co.—The track has been laid on about 180 miles of this road, leaving about 80 miles yet to lay to reach Prince Albert. The grading of this portion of the line will be finished by the end of August, and the whole line is to be completed in October."

Projects and Surveys.

Omaha & South Dakota.—This old project has again been resuscitated and it is stated that the company will be formed at once to build the line.

Fremont and Yankton.—A correspondent writes us that no organization has yet been effected.

Red Lake & Western Ry. & Navigation Co.—Frank Ives, of Crookston, Minn., President, writes that the surveys for this line will be made during September, but that nothing further will be done this year.

Winnipeg & Hudson Bay.—A press dispatch says:

The Winnipeg & Hudson Bay Railway Co. has been informed that upon producing satisfactory evidence of its ability to construct and operate 300 miles of its railway from Winnipeg to Saskatchewan River at or near High Falls the government will ask parliament to grant the company the same aid as that given to the Calgary & Edmonton railway during the last session of parliament. This portion of the road is considered as being a colonization railway, which will open up and make acceptable a fertile

portion of Manitoba and the northwest territories, at present without railway communication.

Port Edwards, Centralia & Northern.—J. E. Nash, of Centralia, Wis., writes as follows:

The surveys have been completed for this road, which is projected to run from Port Edwards, Wis., via Centralia and Vesper, to Marshfield, Wis., a distance of 32 miles, and the right of way has been nearly all purchased. The contracts have been let, and the line is to be completed by Jan. 1, 1891. The principal business of the road will be in timber and timber products. The company was chartered Jan. 21, 1890. E. Baldwin is Chief Engineer.

Kewaunee, Green Bay & Western.—W. J. Abrams, of Green Bay, Wis., writes us as follows:

The preliminary surveys have been completed and the engineers are now locating this railway, which is projected to run from Fort Howard, Wis., via Green Bay, Luxemburg and Casco, to Kewaunee City, Wis., a distance of 34 miles. The work is generally light; maximum grade 45 ft., and this only for a short distance. About ¼ of the right of way has been secured. The company was chartered May 19, 1890. S. B. Fisher, of Green Bay, Wis., is Chief Engineer.

Little Wabash.—Incorporated in Illinois to build a railway from Effingham to Carmi, Ill. Among the directors are: Edward Austin, of Effingham, Ill.; C. E. Hilts, of Sailor Springs, and J. J. McCawley, of Clay City.

Atlantic, Mexico & Pacific.—This company has filed articles of incorporation in Illinois. Its object is to build a railway from Toledo, O., to the Pacific coast.

SOUTHWEST.—Existing Roads.

Gulf, Colorado & Santa Fe.—The work of improvement on the north end of this road is rapidly progressing Steel rails are being put down between Dallas and Paris as rapidly as possible and the work will probably be completed by July 15. Six trainloads of gravel a day are being brought from the Frisco pits near Talihina, I. T., to be used in ballasting the track.

Missouri Pacific.—A press dispatch say.:

The Gould line extension, known as the Houston, Central Arkansas & Northern R. R., having been completed from McGehee, Ark., to the state line of Louisiana, will be opened for business on July 1, and will be operated in connection with the Houston, Central Arkansas & Northern R. R., extending from the State line of Louisiana to Riverside, La. The official circulars announcing the fact have been issued from the Missouri Pacific general offices. The Missouri Pacific officers will operate the line. It extends over 118 miles, from McGehee, Ark., to Riverside, La.

Atchison, Topeka & Santa Fe.—The Wichita, Kan., Board of Trade has received official information that a line will be built by this company from Mullinsville, Kan., to Dodge City, Kan.

Projects and Surveys.

Manhattan, Newton & Gulf.—At a recent meeting of the directors of this company the following officers were elected: President, A. L. Williams, of Topeka, Kan.; First Vice-President, S. R. Peters, of Newton, Kan.; Second Vice-President, S. M. Fox, of Manhattan, Kan.; Secretary, John C. Johnston, and Treasurer, E. H. Hoag, both of Newton.

North Texas & Gulf.—Chartered in Texas to build a railway from Jefferson toward Sabine Pass, a distance of 230 miles. Among the incorporators are: E. W. Taylor, of Fort Worth; C. A. Ginochio, of Marshall, and G. M. D. Grigsby, of Jefferson, Tex.

Paris, Marshall & Sabine Pass.—At a recent meeting of the stockholders, authority was given to J. W. Harle to contract for the construction of 25 miles of the line from Marshall, Tex., south. It is stated that further contracts will be let soon.

Houston, Central Arkansas & Northern.—The contract for building this road from Riverside to Alexandria, La., has been awarded to J. A. Henry, of Joliet, Ill., the work to be completed by Jan. 1, 1891.

ROCKY MT. AND PACIFIC.—Existing Roads.

Northern Pacific.—The engineers have nearly completed the surveys for the Yakima & Pacific Coast R. R. from South Bend to Chehalis, Wash. Grading will, it is stated, commence in a few weeks.——The Pony & Norris Branch running from Sappington to Pony and Norris, Mont., has been completed. The distance from Sappington to Pony is 17 miles, and from Sappington to Norris is 21 miles.——It is stated that the contract for the belt line around Lake Washington at Tacoma has been let to Henry & Balch, of Minneapolis, Minn. The new line to be built will be about 20 miles long, which with the portion already operated by the Seattle, Lake Shore & Eastern R. R., will make the total circuit 60 miles. It is expected that the line will be completed by Jan. 1, 1891.

Oregon Improvement Co.—President Elijah Smith, of the Oregen Improvement Co., has approved the surveys for a ten-mile railway in Southern Oregon, extending from Empire City, on Coos Bay, south to the Coquille River. Work will be commenced immediately in the construction of this new road. It is said to be the ultimate purpose to extend the road through the valley of the Coquille River to a connection with the Mount Shasta route at Roseburg.

Oregon.—A press dispatch from San Francisco, Cal., says:

The prospects are favorable for considerable railway activity in Southern Oregon. Four projects are in contemplation, all having in view Coos Bay as their terminal point. The Southern Pacific Company is said to be behind one of the schemes, and so is the Oregon Improvement Company, while the other two projects are being pushed by private individuals. Elijah Smith, President of the Oregon Improvement Company, is reported as now on his way to the coast to order commencement of the work on his company's proposed road. It is intended this summer to construct ten miles of road from Empire City, which is on Coos Bay, south of the Coquille River, a distance of ten miles. The final surveys have all been completed and approved by President Smith. The ultimate idea of Smith is said to be an extension east through the valley of the Coquille River to a connection on the Mount Shasta route at Roseburg. The project that the Southern Pacific Company had in view is a branch line from Eugene City, on the Mount Shasta route, which will run in a southwesterly direction to Coos Bay. The third scheme is that of some Chicago and San Diego people, who have organized the Coos Bay, Roseburg Eastern Railroad & Navigation Company, to build a road 75 miles long from Marshfield to Roseburg, where connection will be made with the Mount Shasta route. The citizens of the two towns mentioned have jointly raised a subsidy of $150,000 for this road. The fourth scheme is that of some Oregon and Chicago people, who propose building a road from Drains, on the Mount Shasta route, just south of Eugene City, to Coos Bay via Elkton.

Northern Pacific.—Smith & Howell, of North Yakima, Wash., who have the contract for building the line from Whelan, Wash., to Lewiston, Idaho, have about 500 men at work on the line and will soon increase the number to 2000.

"Calgary & Edmonton.—Money has been provided for 300 miles of this line, for 200 miles from Calgary north to Edmonton and 100 miles south from Calgary toward the International boundary. The surveys are about completed and a contract has been made between the company and James Ross, Windsor Hotel, Montreal, P. Q., for the completion of the whole line including rails, stations, roundhouses, etc.; 250 miles to be completed in 1891 and the balance in 1892. Supplies and material are now being purchased and the work started at Calgary. The Canadian Pacific Ry. Co. will operate the line when completed.

Projects and Surveys.

San Francisco & Los Angeles.—A convention of delegates from the counties interested in the completion of a railway along the Pacific coast from San Francisco to Los Angeles, Cal., met in San Jose, Cal., last Wednesday and adopted resolutions pledging itself to secure rights of way, station grounds, and to subscribe to $50,000 for the first mortgage bond on the part of the road to be completed, on condition that the Southern Pacific resume active work on the gap of 172 miles between Santa Margarita and Ellwood, Cal.

Lakeport & Ukiah.—It is stated that a company has been organized to build a railway from Lakeport to Ukiah, Cal., a distance of 32 miles. The line has been surveyed and is estimated to cost $720,000. D. S. McDougal, of Lakeport, Cal., is at the head of the enterprise.

FOREIGN.

Mexican Northern.—Articles of incorporation of this company have been filed with the New York Secretary of State. The company proposes to build a line of railway in Mexico from a point on the Mexican Central Ry., within 15 miles north or south from Escalon, northeast to the district of Sierra Mojada. The company, in connection with its railroad, will also open telegraph, telephone and steamboat lines. This company has valuable concessions, which were granted to it by the authorities of Mexico in March, and is about to establish smelters and metallurgical works there. The directors of the company are Robert S. Towne and August R. Meyer, of Kansas City; Nathaniel Witherill, of New York City; Edward M. Shepard, of Brooklyn; A. Foster Higgins, of Greenwich, Conn., and Chas. J. Nourse and Nelson S. Spencer.

Mexico.—The government has granted a concession to Gonzalo Aestiva for a railway to run from Guadalajara to Chamela.

CITY TRANSIT.

Horse Railways.—*Lake Village, N. H.*, will have its lines extended.

New Rochelle, N. Y.—The railway from this place to Pelham was sold recently under foreclosure for $170,000.

Newark, N. J.—All the street railway lines have been consolidated into the Newark Passenger Railway Co.

Proposals for new lines are made in Houston, Tex. Galesburg, Ill., Salt Lake City, Utah, and Corvallis Wash.

Dummy Railways.—*West Portland, Ore.*—The lines will be opened about Sept. 1.

Proposals for new lines are made in Covington and Greenville, S. C.

Cable Railways.—*New York City.*—The 3d Ave. Ry. Co. will proceed immediately to change their line to a cable road. There will be three sections; one from 56th St. north, one from 56th to 6th St., and one from 6th St. to the City Hall. The road will probably be completed by winter.

Duluth, Minn.—The Madison St. line will be opened in a few days.

Dallas, Tex.—A company has been incorporated here by J. M. Harry, T. Field, C. W. Guild and others to build and operate a cable line. Capital stock, $600,000.

Piedmont, Cal.—The San Francisco Tool Co., has been awarded the contract for building the lines here. Their price was $260,000.

Electric Railways.—*Providence, R. I.*—The Julien storage battery cars have been introduced here.

Amsterdam, N. Y.—The lines here have been purchased by New York and Philadelphia parties, and will be operated by electricity.

Pittsburg, Pa.—The Pittsburg, Allegheny & Manchester Ry. is being rapidly pushed. The directors have not yet decided what system of motors to use.

Georgetown, D. C.—The lines will be opened here shortly.

Little Rock, Ark.—The Capital St. Ry. Co., operating 25 miles of street railway in this place and Pine Bluff, contemplate the adoption of electricity for their system.

Paducah, Ky.—A system of lines 8 miles long has been opened.

Olympia, Wash.—The Light & Power Co. has bought Tumwater Falls and is preparing to build a railway to be operated by electricity generated by the water power so gained.

HIGHWAYS.

Maryland.—The commissioners appointed to prepare plans for new roads in Baltimore County have recommended a shell or cinder highway from Chase Station to Stone's Crossing. The right of way has been obtained.

Texas.—The County Judges' Association has recommended that the highways of each county be placed under a bonded officer, who shall be responsible for them. This officer is to have a number of assistants, appointed by the county commissioners upon his recommendation.

BRIDGES, TUNNELS AND CANALS.

Bridges.—*Chicopee, Mass.*—The engineers have completed the location of the bridge across the Connecticut River at this place.

Knoxville, Tenn.—The plans for the West Fifth Avenue have been adopted by the City Council. The bridge will cost $14,626.

Ogden, Utah.—The following bids were received for the construction of the bridge over the Ogden River: Pacific Bridge Co. of San Francisco, $16,000; wooden instead of steel joists, $13,800; Lane Bridge & Iron Works, Chicago, $13,275; The Missouri Valley Bridge & Iron Works of Leavenworth, Kan., $13,350; The King Iron Bridge Mfg. Co. of Cleveland, O., $13,990 for iron and $13,350 for wood stringers; The Chicago Bridge & Iron Co. of Kansas City, $13,490; The Smith Bridge Co. of Toledo, O., plan A. $12,000; plan B, $11,600; plan C, $2,000 added to above bids; plan D, $100 less than above bids. The abutments were not included in any of these propositions.

Tunnels.—Bids will be received until July 23 for constructing locks, weirs, etc., at Morrisburg, Ont., and for the deepening and enlargement of the Rapids Plat Canal. A. P. Bradley, Secretary, Department of Railways and Canals, Ottawa, Ont.

WATER-WORKS.

NEW ENGLAND.

Attleboro, Mass.—Bids will soon be wanted for furnishing a new stand-pipe.

Stockbridge, Mass.—The Water Committee has decided to construct works costing $125,000. A 1,000,000 galls. reservoir will be built.

Newburyport, Mass.—E. P. Shaw has sent us the following information:

The work now being carried on is being done by E. P. Shaw and others, and will consist in laying a pipe from a well at Salisbury beach and erecting a tank.

Springfield, Mass.—The report and plans submitted by the Water Commissioners have been accepted by the City Council. The report calls for an appropriation of $100,000 to purchase water rights and privileges and pay land damages, to bring 7,000,000 minimum and 25,000,000 maximum galls. of pure water per day through 1,700 ft. of 53-in wrought iron pipe, and 3 miles additional canal, to a 10-acre reservoir at the head of the Ludlow structure, which is to be fed principally by Jabish and Broad brooks, and seven smaller streams. The plan also contemplates a waste gate and sluices for drawing down dry the Ludlow reservoir when the independent system is perfected and the cleansing of its bed by freshwater slushing and other methods.

Central Falls, R. I.—A. P. Carpenter, J. E. Thomson and M. Maloney have been appointed committeemen to investigate and report upon the question of obtaining a water supply outside of Pawtucket.

MIDDLE.

Tuxedo Park, N. Y.—Work has been resumed on Dam No. 5 of the Tuxedo Park Association. JAMES S. HARING, Resident Engineer and Superintendent of the Park, is in charge.

Lester-Shire, N. Y.—Regarding the report that works are projected, W. D. Brewster has sent us the following: There are no works in this town and none contemplated

Potsdam, N. Y.—The pumping machinery will be furnished by the Buffalo (N. Y.) Steam Pump Co.

Brockport, N. Y.—Construction work has been commenced. The Buffalo Steam Pump Co. has been awarded the contract for furnishing the pumping machinery.

Black River, N. Y.—Works are to be constructed.

Holly, N. Y.—The contract for furnishing the pumping machinery has been awarded to the Buffalo (N. Y.) Steam Pump Co.

Allegheny, Pa.—Comptroller Brown is preparing plans for drilling a well.

Scottsdale, Pa.—A system of works is to be constructed. A new company has been formed and work on the reservoir at Mount Vernon, 4 miles distant, to supply the town will soon be commenced. Stark Brothers, the contractors, of Greensburg, Pa., hold a majority of

the stock in the new company. The City Council has closed a contract for 35 hydrants.

Macungie, Pa.—Secretary John Erdman informs us that there is no truth in the statement that works are to be put in.

Frostburg, Md.—The following bids have been received for constructing the new reservoir :

Kean & Farrell, excavation, earth, 32 cts.; loose rock, 45 cts.; solid rock, 90 cts. cu. yd.; rubble, $6 per perch; paving, 38 cts. sq. ft.; coping, 60 cts. lin. ft. W. H. Koch, earth, 37½ cts.; loose rock, 45 cts.; solid rock, 75 cts.; puddling, 37 cts. cu. yd. Andrew Smeltz, earth, 32 cts.; loose rock, 50 cts.; solid rock, 90 cts.; puddling, 50 cts. cu. yd. Henry Williams, rubble, $4.35; dry, $2 per perch; paving, 15 cts., sq. ft.; coping, $1.15 cu. ft. Mr. Meyers, earth, 35¾ cts.; loose rock, 49 cts.; solid rock, 65 cts.; puddling, 38¾ cts. cu. yd. Wm. H. Evans, earth, 29 cts.; loose rock, 43 cts.; solid rock, 70 cts.; puddling, 29 cts., cu. yd ; overhaul, 10 cts. Owen England, earth, 33¼ cts.; loose rock, 40 cts.; solid rock, 70 cts.; puddling, 30 cts., cu. yd. J. B. Martin, earth, 27½ cts.; loose rock, 45 cts.; solid rock, 70 cts.; puddling, 29 cts., cu. yd.; overhaul, 10 cts. The contract for excavating was awarded to Wm. H. Evans, and for the masonry work to Henry Williams.

SOUTHERN.

Palaski City, Va.—It is reported that bids will soon be wanted for constructing a system of works.

Camden, S. C.—Correspondence with contractors is solicited by J. W. Corbett for estimates for constructing works.

Union, S. C.—Address the Mayor regarding the projected works.

Macon, Ga.—A site for erecting a stand-pipe and constructing a dam is being located. Mr. McBurney, President of the Ocumlgee Land and Improvement Co., has charge of this work.

Griffin, Ga.—Mayor Stewart, Alderman H. C. Burr, S. H. Deane and M. J. Patrick have been appointed a committee to confer with parties desirous of putting in works A later report states that the proposition made to the town by W. J. Robinson, on behalf of a company, has been accepted and signed, by the terms of which the works are to be in operation within 90 days. Forty hydrants will be set for which the city will pay $50 each for 20 years; the citp to own one fourth of the plant after paying $2,000 annually for 5 years.

Greenville, Ala.—The new works will be built by the American Pipe Mfg. Co., of Philadelphia, Pa.

Warrior, Ala.—Address the Pearson Coal, Iron & R. R. Co. for information regarding the projected works.

Vicksburg, Miss.—It is probable that additional sup ply wells will be sunk by the water company.

Spring City, Tenn.—C. G. Buell has sent us the following regarding the published account that works were to be built:

No decisive action will be taken at present.

Parkland, Ky.—At a recent mass meeting to consider the question of a water supply and of having the water company lay mains to the town, a committee on "Ways and Means" was appointed to investigate the matter.

Shelbyville, Ky.—A citizens' vote will soon be taken on the question of establishing works. Address L. C. Willis.

NORTH CENTRAL.

Marysville, O.—The members of the local water company, which has been granted a franchise, are: Walter Fullington, John Zwerner, George McPeck and Jerome Davis. Work is to be commenced at once.

Crawfordsville, Ind.—The water-works plant has been sold under an order of the court procured by the American Loan & Trust Co., at $106,700. Coffin & Stanton, of New York, are the purchasers.

Goshen, Ind.—Superintendent Lew Wanner has sent us the following:

The improvements to the water plant will consist of putting in a new pumping engine, increasing the supply and laying about 1,500 ft. of 14-in. cast-iron pipe and setting two new hydrants.

Frankfort, Mich.—We have received the following information:

The contract for complete works has been awarded to the Michigan Pipe Co., of Bay City, Mich. Henry B. Smith is Secretary and Treasurer. The plant will include the following: Pump-house, 2 sets of duplex pumps, 1 reservoir, 6,162 ft. 3-in. mains, 6,197 ft. 4-in., 5,021 ft. 6-in., 2,133 ft. 8-in., 34 hydrants and 21 valves. The works are to be completed by Dec. 1.

Chicago, Ill.—Commissioner Purdy has awarded the contract for furnishing the water pipe which is designed to give relief to the towns of Hyde Park and Lake to Dennis Long & Co., of Louisville, Ky., at $112,350. The pipe must be delivered between July 12 and Aug. 20, and will be laid as rapidly as it is received.——On July 7, the contract will be let for furnishing 120,000 ft. of 6-in. pipe.

Genoa, Ill.—D. W. Hartman, Editor of the Genoa *Issue*, has sent us the following information:

The question of building works was recently defeated by a citizen's vote. The Board has the power to bond the town for works, not to exceed 5 per cent. of the assessed valuation, but it is reported as probable that no further steps will be taken at present.

Muskegon, Mich.—All the bids opened on June 24 for the purchase of $250,000 of water bonds have been rejected by the Common Council. These bonds have been issued for making the improvements published in detail in ENGINEERING NEWS of May 3, page 429, from official returns, a report upon which has recently been submitted to the Council by the Consulting Engineers, Chester B. Davis and J. W. Alvord, of Chicago, Ill. It has been decided to take the new supply from two wells instead of the river.

NORTHWESTERN.

Des Moines, Ia.—Bonds for $100,000, bearing 6% interest, are being offered for sale by Swan & Barrett, of Portland, Me.

Council Bluffs, Ia.—The question of constructing a high service system is being discussed.

Sioux City, Ia.—The city is threatened with a water famine.

Orleans, Neb.—The new works are nearly completed.

Beatrice, Neb.—Smith Brothers, of Beatrice, were the successful bidders for the $26,000 water and intersection bonds. Their bid was $26,018.

Fargo, No. Dak.—The city has voted to issue bonds for the proposed improvements.

SOUTHWESTERN.

Palmyra, Mo.—The new works will be constructed by W. H. Allen.

Houston, Tex.—The charter of the Houston Water Co. has been amended to allow it to increase the capital stock to $150,000.

Waxahachie, Tex.—Supplies, including a stand-pipe, hydrants, pipe, etc., will be purchased by the Waxahachie Water Co.

Guthrie Center, Ind. Ter.—The City Council has contracted for a water-works plant to have a daily capacity of 500,000 galls.

PACIFIC.

Seattle, Wash.—The Northwest Water Co. has been incorporated at Olympia with a capital stock of $100,000.

Edson, Wash.—It is reported that the Samish Water Co. will put in works.

Goldendale, Wash.—We have received the following information from W. B. Presley, City Clerk:

Contracts will be let about Aug. 1. The works are to be built by the city. The estimated cost is $12,500, to be procured by town bonds. Water will be pumped from Klukitat River to a stand-pipe. The following materials will be purchased: 30 hydrants; 1,850 ft. 8-in. pipe; 3,300 ft. 6-in.; 10,700 ft. 4-in.; two pumps, one boiler, valves, etc.

Mount Tabor, Ore.—The Mount Tabor Light and Water Co. has been incorporated by J. D. Hart, C. F. Swigert and H. C. Campbell to furnish water and light. Capital stock $20,000.

Stockton, Cal.—An appropriation of $35,000 has been made for completing the works.

Los Angeles, Cal.—At a recent mass meeting a resolution was passed stating it to be the immediate duty of the city to take such action as will result in the city establishing, maintaining and controlling its own works, and a committee consisting of C. N. Earl, E. W. Jones, William Niles and others has been appointed to have charge of the matter.

Provo City, Utah.—A company will put in a system of works to cost $300,000.

CANADA.

Antigonish, N. B.—The town has voted to expend $35,000 in constructing works.

ARTESIAN WELLS.

Florence, S. C.—Estimates for sinking a well are wanted by C. L. Stickney & Co.

O'Neil, Neb.—The town will expend $3,000 in putting down a well.

Seward City, Neb.—The City Council has decided to sink the well to a depth of 600 ft.

Glendive, Mont.—New machinery will have to be purchased if the well is put down further than its present depth, 500 ft.

Sherman, Tex.—A well is to be sunk. Address the Mayor.

Heppner, Ore.—The well has reached a depth of 204 ft,

IRRIGATION.

Baker City, Ore.—The Baker County Irrigation Co. has been incorporated with a capital stock of $350,000. The incorporators are: E. H. Mix, E. Hardy, C. W. James and B. F. Holbrook. They will take water from Powder River and build a large canal to irrigate farms throughout the Powder River valley.

Washington, D. C.—A bill has been reported by Senator Moody from the Select Committee on Irrigation and Reclamation of Arid Lands, being an amendment to the Sundry Civil Bill, making an appropriation of $200,000 to investigate the arid region of the United States for the purpose of discovering to what extent it can be redeemed by irrigation; also an amendment making an appropriation of $250,000 to enable the Secretary of Agriculture to cause surveys and field examinations to be made to ascertain the value of under-flow waters for irrigation within the region lying on the eastern slope of the Rocky Mountains.

Chamberlain, So. Dak.—An artesian well for irrigating purposes will be sunk in Chamberlain Township, Brule Co.

Payette, Idaho.—A canal is to be constructed and an irrigation system established in this vicinity by G. W. Bartch, of Salt Lake City, Utah. The canal will tap the Payette River, near Emmett.

Antonito, Col.—It is reported that the Taos Valley Ditch Co. will soon commence work on their irrigation canal at this place. The company proposes to engage only bona fide settlers to do the work, enabling them to work out their water rights and giving them all the benefits.

North Yakima, Wash.—Three parties of engineers are now engaged in the construction work of the canal of the Northern Pacific and Yakima Irrigation Co. Detailed estimates place the cost of the canal at $600,000.

Ellensburg, Wash.—A large majority vote has been cast in favor of forming five irrigation districts in this vicinity. Preliminary surveys have been made for a canal 40 miles long to run from Lake Cle-Elum. One short tunnel and a small amount of trestle work will be necessary. About 125 acres of land will be reclaimed by this canal.——Supplementary articles of incorporation of the West Side Irrigation Co. have been filed. The capital stock will be increased from $10,000 to $30,000.

Los Angeles, Cal.—The Big Rock Creek Irrigation District has been formed.

Cruces, N. M.—Surveys for the Mesilla Valley canal are now being made and construction work will soon be commenced.

SEWERAGE AND MUNICIPAL.

Sewers.—Marlboro, Mass., has voted $125,000 for sewers, which must be finished in November, 1892.

Berlin, N. Y., proposes to build sewers, costing in all 15,000.

Hoosick Falls, N. Y.—The committee appointed to report upon the proposed system estimate the cost at $40,000. E. D. Smalley will prepare the plans and specifications.

Poughkeepsie, N. Y., will probably build a trunk sewer at an estimated cost of $20,000.

Passaic, N. J., has ordered a complete Waring sewerage system.

Newark, N. J.—The great majority of the Mill Brook assessments have been confirmed by Judge Depue. The amount affected is $86,000.

Mobile, Ala.—Col. G. E. Waring, Jr., has planned a system of sewerage.

Los Angeles, Cal., has begun work on the western intercepting sewer, which will be 15,000 ft. long and 24 in. in diameter, with manholes every 500 ft.

East Oakland, Cal., will build a sewer on Commercial St. at an estimated cost of $45,000.

Streets.—Buffalo, N. Y., has ordered its city engineer to prepare estimates for considerable asphalt and Medina pavement.

Brooklyn, N. Y., has $1,000,000 available this year for granite street repaving. About $600,000 of this amount has already been spoken for.

Troy, N. Y., has authorized a large amount of grading.

Dunkirk, N. Y., will macadamize several highways.

Newark, N. J., has $675,000 for street work.

Pittsburg, Pa., has voted to open a number of new streets.

Washington, Pa., will vote July 5 as to issuing $150,000 of bonds for street improvement and sewerage. Wilson & Smith have prepared the plans for the street work. The Waring sewerage system will be adopted.

Wilkesbarre, Pa., will replace all its cobble pavement with asphalt.

Westminster, Md., will macadamize its streets, the cost being met by $25,000 of new 4½% bonds.

Columbus, O., has ordered a number of streets to be paved with brick or asphalt.

Newark, O., has appropriated $2,500 for repairing pavements.

Springfield, Ill., will lay a large amount of cedar blocks during the summer.

River Front, Ill., has ordered considerable macadam and cedar block pavement.

East St. Louis, Mo., has decided to improve a number of streets.

Independence, Mo.—Residents on the south side boulevard are endeavoring to have the street railway declared a nuisance by the council. If successful they will grade, curb and pave the street, making a drive nearly 4,000 ft. long and 100 ft. wide.

St. Louis, Mo., has street work on hand estimated at $421,000.

Omaha, Neb., has forbidden the laying of wooden sidewalks within fire limits.

Denver, Colo., has ordered asphalt to be laid on two important streets.

Bonds.—New Rochelle, N. Y., will issue $50,000 of sewerage bonds.

New York City will issue $187,000 of school house bonds.

West Troy, N. Y., will sell $50,000 of pavement bonds on July 8.

Winston, N. C., will issue $200,000 of improvement bonds.

Providence, R. I., will build a street subway to contain steam pipes and electrical wires, the idea being to furnish steam for heating and electricity for lighting and power to all the lots included in the Duncan estate. Mr. George F. Leete, manager of the Duncan estate, is at the head of the enterprise.

ELECTRICAL.

Electric Light.—Woodsville, N. H., will issue $10,000 of bonds for an electric light plant. E. B. Mann will make the contracts.

Hamburg, Pa., is negotiating for a plant. L. E. Snow can give information.

Baltimore, Md. The Maryland Electric Co. has ordered a 1,500 arc light plant. The Volta Electric Battery Co.

has been incorporated with a capital stock of $300,000 to manufacture batteries for electric lights.

Burlington, Va. The company here will increase its plant.

Iron Gate, Va., wishes to buy a plant. A. J. Acord can give information.

Pulaski City, Va., will soon advertise for a plant. The mayor can give particulars.

Charlotte, N. C. The company here will enlarge its plant.

Wilson, N. C. The Wilson Cotton Mills will put in a plant.

Union, S. C., will probably purchase another plant.

Selma, Ala. The Matthews Cotton Mills Co. expects to put in a plant shortly.

Gadsden, Ala. A plant will be established here by Banks, Arnold & Co.

Fort Payne, Ala. The Light & Power Co. will increase its plant.

Gainesville, Ga., will issue $40,000 of bonds for electric light and water-works.

Kensington, Ga. The Coal and Iron Co. will erect a plant.

Quitman, Ga., will soon have a plant. E. P. S. Denmark can give information.

Vosburg, Miss., will establish a plant.

Yazoo City, Miss., has granted the contract for its lights and water-works to the Thomson-Housten Co. for 20 years.

Ennis, Tex., will establish a plant. The Mayor can give information.

Austin, Tex. The Rapid Transit Co. will erect a plant.

Lawrenceburg, Tenn. The Lawrenceburg Land Co. will build a plant.

Denver, Colo., has awarded the contract for lighting to the Western Co., which will furnish 2,000 candle power lamps at $10 per month.

Proposed. Plants are talk of in the following places: Old Town, Me.; Crewe, Va.; Dayton and Chattanooga Tenn.; Henderson and Versailles, Ky.; Algona, Ia.; Sioux City, Neb.; Wallace, Idaho; Olympia, Wash.

CONTRACTING.

Streets.—St. Paul Minn.—About 26,000 sq. yds. of cedar pavement have been awarded to J. Snyder and T. J. Canney at a cost of $22,500.

Jay, Vt.—The contract for building a highway, has been given to E. Bowen, at $4 per rod.

Pittsburg, Pa.—The contract for grading California Ave., has been given to Hastings & Dunn, for $46,820.

Rochester, N. Y.—The Rochester Vulcanite Pavement Co., has received the contract for paving North St. Paul St., for $51,000; the Warren-Sharf Co. received the Lorimer St. paving at $22,070. The Oxford St. brick pavement contract has been given to Hagaman, Oliver & Co., for $16,614. The lowest bid for macadamizing 2,500 sq. yds. of street was $1.18 per yard.

Machine Tools.—With the consent of all the bidders in the machinery for the Washington Navy Yard, the award of the contract will be left to a board of civilian experts made up of Prof. SWEET of Syracuse, Mr. WELLMAN of Cleveland, and Mr. MORGAN of Worcester.

Sewers.—St. Paul, Minn.—W. C. Doherty has been awarded a number of sewers at a total cost of $14,538.

Rochester, N. Y.—The following bids for supplying cast iron pipe were opened:

BIDDERS.	12-in.	10-in.	8-in.	6-in.	4-in.	Castings.	Total.
Donaldson Iron Co., Emaus, Pa.	$24.53	$24.53	$24.53	$24.53	$26.00	2.04 cts.	$13,436
Buffalo Cast Iron Pipe Co., Buffalo, N. Y.	26.00	26.00	26.25	26.50	26.50	.....	15,688
Jackson & Woodin, Berneh, Pa.	25.75	25.75	25.75	25.75	25.75	2.04 "	14,016
Mellert Foundry and Machine Co., Reading, Pa.	26.40	26.40	26.40	26.40	26.40	2.5 "	14,405
Warren Foundry and Machine Co., Phillipsburg, N. J.	25.70	26.70	26.70	26.70	26.70	2.425 "	14,476
Utica Pipe Foundry Co., Utica, N. Y.	26.50	27.00	26.50	26.50	27.50	2.5 "	14,557
R. D. Wood & Co., Philadelphia, Pa	27.80	27.80	27.80	27.80	27.80	2.06 "	15,133

The contract was awarded to the Donaldson Iron Co. The Genesee St. outlet sewer was awarded to W. Fuller for $36,047.

Levees.—Clarksdale, Miss.—800,000 cu. yds. of levee work have been let at an average price of 20.5 cts. per cu. yd., work to be completed by Dec. 1.

Bridges.—Pueblo, Colo—The Bullen Bridge Co. has been awarded the contract for building a wrought iron viaduct, costing $56,489.

W. R. H. also asks for the same information on the subject of laying submerged iron pipe, as did H. C. in our issue of June 28.

Lathes.—The Board of Experts to award contracts for the Washington gun foundry have accepted the bids of Wm. Fellers & Co., of Philadelphia, for the 8 large lathes. The price was $416,460.

PROPOSALS OPEN.

Paving.—Wooden, stone and asphalt. The asphalt and wooden pavements must be guaranteed for 10 years. P W. St. George, Montreal, P. Q. July 9. About 6 miles of asphalt, granite or brick. L. G. Walker, Chattanooga, Tenn. July 10. Vitrified brick with broken stone foundation. T. E. Warner, North Tonawanda, N. Y. July 14 Cobble stone. J. J. Adams, Brooklyn, N. Y. July 14.

Grading and Paving.—R. L. Gorman, St. Paul, Minn. July 8, and A. E. Smyrk, Baltimore, Md. July 7.

Pavement to be of medina sandstone with concrete ointa. C. G. Force, Cleveland, O. July 24.

Grading and Filling.—About 7,000 cu. yds. on David's Island. Capt. Hyde, David's Island, N. Y. July 10.

All grading and masonry for change of line of Union Ry. from east end of Union Ry. tunnel to a point 1 mile east thereof. W. H. Brown, 233 S. 4th St., Philadelphia, Pa. July 8.

New Jersey.—Wise & Wilson are preparing plans and specifications for macadamizing a number of roads in Bergen County.

Street Improvement.—A. C. March, Bond Hill, O., July 14, and F. Raine, Cincinnati, O. July 23.

Dredging.—About 18,000 cu. yds. E. Hannon, Albany N. Y. July 8.

Granite.—About 2,200 cu. ft. for dry dock at Mare Island. E. Stewart, Navy Department, Washington, D. C. July 22.

Wrought Iron Caisson.—For dry dock at Kingston, Ont. A. Gobeil, Ottawa, Ont. July 18.

Cement.—J. W. Douglas, Washington, D. C., July 10.

Repairing Pier.—No. 57, North River. Department of Docks, New York City. July 16.

Terra Cotta Pipe.—1,000 ft. 6-in.; 200 ft. 8 × 6 in. Y branches; 1,000 ft. 8 in.; 4,000 ft. 12 × 6 in. Y branches; 40,000 ft. 12-in.; 1,200 ft. 15 × 6 in. Y branches; 8,000 ft. 15 n.; 1,000 ft. 18 × 6 in. Y branches; 3,500 ft. 18 in.; 300 ft. 21 × 6 in. Y branches; 2,000 ft. 21-in.; 200 ft. 24 × 6 in. Y branches; 3,000 ft. 24 in. District Commissioners, Washington, D. C. July 10.

Cast-Iron Pipe.—13,345 ft. of 8-in., 42 lbs. a ft.; 10,540 ft. of 6-in., 33 lbs. a ft.; 3,066 ft. of 4-in., 22 lbs. a ft.; about 22,236 lbs. of special castings, 29 double-valve Matthews fire hydrants, 10 8-in. Ludlow valves, 8 6-in. and 5 4-in.

Draughting Supplies for the U. S. Signal Service. Gen. A. W. Greely, War Dept., Washington, D.C. July 14.

Electric Lighting.—In the streets of Los Angeles, for two years beginning Jan. 1, 1891. F. G. Teed, Los Angeles, Cal. July 14.

Bridges.—Wrought Iron bridge over Pigeon Creek. J. D. Pervin, Evansville, Ind. July 18.

Designing and constructing bridge over Eel River. O. D. Stern, Alder Point, Cal. July 15.

Wrought iron, steel or combination bridge. Also wooden bridge, 140 ft. long, with 16 ft. roadway. F. J. Reinhard, Franklin County, O. July 17.

Buildings.—A chapel, library and museum for the Iowa Agricultural College. E. W. Stanton, Ames, Ia. July 17.

The brick, stone and iron works for the Tacoma Chamber of Commerce. Hatherton & McIntosh, Tacoma, July 12.

Dam.—The Missouri River Power Co., of Helena, Mont., has advertised for bids to construct a dam across the river at that place. The company intends to use the power so obtained for generating electricity.

Sewers.—Four thousand feet separate system; also bids for 1,500 ft. 15 in. and 2,000 ft. 12 in. S. W. pipe and 550 ft. 16-in. iron pipe. D. C. Barrow, Jr., Athens, Ga. July 20

Seven miles of pipe sewers varying from 8 to 20 ins. in diameter, with necessary manholes, basins and tanks, Wise & Watson, Passaic, N. J. July 7.

Brick sewers are as fellows: 950 ft., 3 × 4.5 ft., 1,250 ft., 2 ft. 10 in. × 4 ft. 3 in., 900 ft. 3 ft. 6 in. × 4 ft. Salt-glazed vitrified pipe as follows: 610 ft. 8 in., 2,300 ft. 15 in., 1,100 ft. 12 in., 1,100 ft. 10 in.; 42 manholes and 43 catch basins. E. B. Gaddis, Newark, N. J. July 18.

Bids are wanted by R. L. Gorman, St. Paul, Minn., July 8; J. J. Adams, Brooklyn, N. Y., July 9, and C. G. Force, Cleveland, O., July 10.

About 5,000 ft. of 12 and 15-in. pipe and 240 of 48-in., 160 ft. of 20-in., and 1,120 ft. 30-in. brick sewers. J. A. Coleman, Providence, R. I. July 10.

Lift Lock.—A. P. Bradley, Ottawa. July 23.

Launching Ways.—In the Brooklyn Navy Yard. N. H. Farquhar, Navy Yard, Brooklyn, N. Y.

Removing Wrecks of the steamers Trenton and Vandalia in Apia, Samoa. W. Blacklock, Apia, Samoa Islands. Aug. 15.

Grading, Blasting and Draining.—30 acres. B. S. & G. S. Olmsted, 32 Liberty St., New York City. July 15.

MANUFACTURING AND TECHNICAL.

Locomotives.—The R. I. Locomotive Works are building three compound engines for one of the Brooklyn elevated roads.

The Baldwin Works have recently shipped four 45-ton engines to the Cincinnati, New Orleans & Texas R. R. and are now working on 10 66-ton express locomotives for the Baltimore & Ohio R. R.

The Brooks Works have sent the first of 10 passenger engines ordered by the Cleveland, Cincinnati, Chicago & St. Louis Ry. The remainder will be finished in three weeks.

The Missouri, Kansas & Texas Ry. will build six mogul engines at their shops in Parsons, Kan.

Cars.—The Erie, Pa., Car Works have orders for 10,000 cars for the Pennsylvania, 5,000 for the Union Pacific, 3,000 for the Missouri Pacific, 4,000 for the Baltimore & Ohio, 3,000 for the New York Central, 2,000 for the Columbus, Hocking Valley & Toledo, and 2,000 for the Cleveland Cincinnati, Chicago & St. Louis lines.

Car Works have been started at Bluffton, Ala. C. B. Parker is manager.

Car Couplers will be given a public examination by the Board of Railroad Commissioners of Massachusetts on July 8, at Boston. Parties desiring to submit couplers must do so before 10 A. M. on that date.

The Iron Car Co., will be reorganized by a syndicate, headed by Brown Bros. & Co., which will put $600,000 capital into the company.

The Thomson-Electric Welding Co. will furnish seven new welding machines to the Roeblings at Trenton, N. J., and complete plants to the navy yards at Brooklyn and Norfolk. The Pennsylvania R. R. have ordered a plant for their works in West Philadelphia.

Fencing.—The Oregon Short Line will set wire fencing along their tracks from Green River to Huntington.

Railway Buildings.—New depots are planned at Fond du Lac, Wis.; Kearney, Neb.; Bonham, Tex.; Portland, Ore.; Greensburg and Roanoke, Va.

The specifications for the Northern Pacific shops at Ellensburg, Wash., call for a round-house with 15 stalls, a 60 × 112 ft. machine shop, a 23 × 40 ft. engine house, and a 39 × — ft. foundry.

Public Buildings.—Natchez Miss., has voted a $25,000 jail.—St. Joseph, Mo., will expend $200,000 in new school buildings.—Portland, Ore., has voted a $500,000 city hall.

Masonic Temple Assoc., at Chicago, Ill., will erect an 18-story building with a frontage of 170 ft. at a cost of $2,000,000

The Railway Supply Works, at Birmingham, Ala., which were burnt recently, are to be rebilt at once.

The Standard Undergroud Cable Co., will remove its plant from Pittsburg to Brinton Station, Pa., where the directors will found a town on the same plan as Pullman, Ill.

A New Lighthouse, will be built at Portland, Ore., at an estimated cost of $95,000.

The Fulton Iron Works, at S. Louis, Mo., are making 4 flywheels 24 ft. in diameter for a cable road in the city.

Gas Companies in Florence, Ala., Basic City, Tex., and Frankfort, Ky., will enlarge their plants.

Pipe Works have been built at Thomas and Bessemer Ala.

New Companies have been incorporated as follows: The American Gas Investment Co. at Jersey City, N. J., by G. S. Bixby, H. W. Thomas and W. Talcott, with a capital stock of $2,500,000. The C. H. Dunham Railway Equipment Co. at Chicago, Ill., by I. Veeder, A. R. Barnett and W. M. Reem, with a capital stock of $1,000,000. The Cloud Rail Joint Co., at Chicago, Ill., by I. Veeder O. R. Barnett and P. R. Shumway, with a capital stock of $500,000. The Standard Steel Brake Beam Co., at Chicago, Ill., by E. Glogan, A. M. Sullivan and A. M. Stewart, with a capital stock of $1,000,000. The Columbus Sewer Pipe Co., at Chicago, Ill., by E. P. Meyersberg, M. F. McCarthy and N. G. Neuhoff, with a capital stock of $500,000.

Metal Market Prices.—*Rails*—New York: $31 to $31.50; for old iron rails, $24.50 to $25.75. Chicago: $34 to 35; old rails, $25.75 to $26 for iron, $18 to $21.50 for steel. Pittsburg: $31.50 to $32.50; old rails, $26.50 to $27 for iron, $21 to $22.50 for steel.

Foundry Pig-iron.—Chicago: $15 to $17. Pittsburg. $14.50 to $18. New York: $16 to $18.50.

Track Materials.—New York: steel angle bars, 1.8 to 1.9 cts.; spikes, $2.05 to $2.10; track bolts, 2.8 to 3 cts. with square, and 3.10 to 3.15 cts. with hexagon nuts. Pittsburg: splice bars, 1.95 to 2.05 cts. for iron; spikes, 2.15; track bolts, 2.85 with square, and 3 cts. with hexagon nuts. Chicago: splice bars, 2.10 to 2.15 cts. for steel, and 1.95 to 2 cts. for iron; spikes, $2.00; track bolts, 3 cts., with hexagon nuts.

Pipe.—Cast-iron, $27 to $30 per ton. Wrought iron, discounts as follows: 47½ and 40 per cent. on black and galvanized butt-welded; 60 and 47½ on black and galvanized lap-welded. Casing, 50 per cent.

Lead.—New York, 4.35 cts.; Chicago, 4.3 to 4.5 cts.

Structural Material.—Pittsburg: angles, 2.25 cts.; tees, 2.75 cts.; beams and channels, 3.10 cts.; sheared steel bridge plates, 2.75 cts.; universal mill plates, 2.40 cts.; refined bars, 1.90 to 2 cts.; steel plates, 4.25 to 4.75 cts. for fire box: 3.15 to 3.20 cts. for flange; 3 cts. for shell, 2.75 cts. for tank. New York: beams, 3.10 cts., plates, 2.15 to 2.20 cts.; angles, 2.25 cts.; tees, 2.5 to 2.6 cts.; channels, 3.1 cts.